LIARD RIVER HYDROELECTRIC PROJECT

PRELIMINARY SOCIO-ECONOMIC IMPACT ANALYSIS

Report No. ESS-12 May 1980

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The information in this document may be incomplete and is subject to amendment as a result of subsequent studies.

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1	Liard Study Region

SUMMARY AND RECOMMENDATIONS

This preliminary study of the socio-economic impacts of the proposed Liard River hydroelectric project produces a comparative analysis of the four alternative schemes of hydro development, namely Schemes 2, 7, 7A and 8. The purpose of the analysis is to provide an information base to be used together with other study findings in selecting one of the schemes for further studies.

The analysis focuses on identifying potential impacts on regional population, employment, income, infrastructure and community development, and distinguishing short-term impacts from long-term effects. Short-term impacts are those occurring during the project construction period. Long-term effects are those associated with the operation phase of the project.

The study region comprises the B.C. and Yukon portions of the Liard River Basin, with Fort Nelson (B.C.) and Watson Lake (Yukon) being the major population centres. Downstream effects in the Northwest Territories would be those associated with project-induced changes in the river regime in the Lower Liard River and the Mackenzie River. Pending further information in the area, such downstream impacts will be explored in a later study. The focus of this study is primarily on the Watson Lake and Fort Nelson Regions.

The analysis was conducted using only secondary data sources. No exploratory research to obtain primary data was carried out.

The results of this preliminary analysis suggest that the differences in employment and income effects among the four proposed schemes are small. However, in terms of direct settlement displacement, Scheme 7 would have the highest negative impact, potentially displacing 380 people (primarily from the two Indian communities of

Lower Post and Upper Liard) and 28 businesses, followed by Scheme 7A, potentially displacing 190 people and 25 businesses, avoiding the Indian settlement of Upper Liard. Both Schemes 2 and 8 would have the same direct displacement impact, involving 40 people and 20 businesses, located along the Alaska Highway, avoiding both Lower Post and Upper Liard. All four schemes would inundate the Muddy River Indian Reserve (70 ha) situated at the Kechika-Liard river confluence, while both Schemes 7 and 7A would also flood out the Liard River Indian Reserve (217 ha) which is presently partially occupied by the settlement of Lower Post.

Scheme 7 would have the highest demand for labour force during the 12 years of project construction (21 350 man-years), as compared to 18 850 man-years of Scheme 8 which would be the lowest, a difference of 13 percent. Schemes 7A and 2 would demand a labour force of 20 750 man-years and 18 920 man-years respectively. However, during the peak year of construction, Scheme 2 would have the highest labour force requirement (4700 persons). For Scheme 7, Scheme 7A and Scheme 8, the peak labour force requirements would be 4600, 4500 and 4100 respectively, Scheme 2 exceeds Scheme 8 by 15 percent. The marginal difference between the schemes holds true for the comparison of secondary impacts including income, populations, infrastructure demand, requirements for services, etc., because these secondary impacts are derived directly from project employment.

Manpower supply for direct project employment is expected to be mainly from in-migration, as skilled construction personnel available from within the study region would be limited. Assuming no significant job shifting occurs during project construction, not more than 3 percent of this employment would be made up of local residents. In-migration is expected to peak at 3100 workers for Scheme 2, the most labour-demanding scheme during the peak year of construction; 2800 for Scheme 8, the least labour-demanding. Some in-migrant workers would relocate their families in the region, giving a total estimated in-migrant population of 6400 for Scheme 2 and 5300 for Scheme 8 during the peak year of construction.

Non-basic employment generated through local expenditures would range from 6 400 man-years for Scheme 7 to 5 600 man-years for Scheme 8 during the 12-year construction period, with peak year employment varying from 945 jobs for Scheme 2 to 870 jobs for Scheme 8. In-migration is expected to peak at 500 to 460 workers.

As a result of this short-term yet high magnitude of employment increase in the region, the population of the region is expected to increase substantially during the core period of construction, roughly between the second and tenth years of the 12-year period. During the peak year, in-migrant population is expected to reach 7600 people for Scheme 2, and 7100, 7200 and 6500 for Schemes 7, 7A and 8, respectively. This short-term population increase would more than double the present regional population. It is assumed that the large majority of this population increase would be accommodated in work camps, one or more of which may become permanent townsite(s) for operation personnel. The selection and planning of new townsite(s) will be addressed in further studies.

When at full operation, the project would employ a direct labour force of 90 for Scheme 2 and 105 for each of Schemes 7, 7A and 8. Direct plus indirect employment would result in a permanent work force of 160 for Scheme 2 and 190 for each of Schemes 7, 7A and 8. It is expected that all permanent jobs would be filled by in-migrants, resulting in a permanent population increase of 290 to 340, depending on the scheme chosen.

According to government agencies' forecasts of other economic sectors in the study region, the Watson Lake Sub-region would witness substantial increases in economic activities leading to a high level of population increase for the next two decades, but the Fort Nelson Sub-region is expected to witness a downturn in economic developments toward the latter part of the 1980's. The Alaska Highway Pipeline project is expected to generate a very short-term but sizeable demand of labour force for a duration of 3 years (most probably 1983 to 1985).

The net in-migration effect of the Pipeline project would be substantial during construction. Approximately 3500 people would relocate to the region at the peak period. Thus, under the scenario where both the Liard hydroelectric project (Scheme 2) and the Pipeline project were to proceed, the region would receive a net in-migration of 2400 to 6700 people between 1993 and 1994, assuming the in-service date for the Liard project (Site A) to be 1996. During the peak year of Liard project construction (most probably 1990), the total regional population would be close to twice as high as if no development were to take place. However, beyond the construction period population increase due to both the Liard and the Pipeline projects would be a mere net increase of 4 percent.

The estimated income resulting from increased wages and salaries in the region for the 12 years of construction would amount to $499.64 million (1980 dollar value) for Scheme 2, $569.28 million for Scheme 7, $553.70 million for Scheme 7A and $505.38 million for Scheme 8. In the operation phase, total wages and salaries generated by the Liard project would amount to $3.24 million per year for Scheme 2, and $3.78 million per year for each of the other three schemes.

At this stage, it is difficult to forecast the distribution of the in-migrant population in the region. Much depends on the potential new townsite(s) and the facilities and services provided in them. The existing communities of Watson Lake and Fort Nelson could gradually accommodate up to 10 percent of this new population without imposing a burden on the existing and planned infrastructure, including land for housing development and sewerage and water systems.

However, the project would impose requirements for additional social services and facilities, including schools, teaching staff, police, etc., regardless of where the potential in-migrants would relocate, as existing services and facilities are nearing or are at their capacities.

As a result of the "boom-bust" phenomenon associated with the short-term duration of employment and population influx, the region would likely suffer from increased social problems, among which are increases in crime and alcohol abuse. However, such inferences must await further verification, as cursory examination of pertinent data at this stage has led to inconclusive results.

Existing life styles of native people, trappers, guides and local businessmen in the reservoir impoundment area would be disrupted due to forced relocation and loss of food supply and income-generating resources. Indians lacking the necessary skills and training, would be least likely to benefit from the alternative wage employment opportunities offered by the project.

To further refine the analysis, further knowledge of the employment pattern associated with the project in terms of type of jobs, duration of jobs, skill requirements, etc., should be acquired, and an income-expenditure multiplier model to describe the inter- and intra-economic linkages of the study region should be constructed. These are important factors in the impact prediction process, affecting the accuracy of the forecast results.

Understanding of the potential social impacts of the project will require more thorough studies. Exploratory research is needed to complement the study of social indicators. A survey of local residents should be conducted to obtain local attitudes on the project. Perceived social impacts can only be aptly judged by those who would be affected, not by "outsiders".

SECTION 1.0 - INTRODUCTION

1.1 OBJECTIVE OF STUDY

This study is a preliminary analysis of the potential socio-economic impacts of the proposed Liard River hydroelectric development. It forms a part of the environmental feasibility study. The primary objective of the analysis is to provide a comparison of the socio-economic impacts under the four alternative schemes of development currently being considered, namely Schemes 2, 7, 7A and 8. According to the November 1979 B.C. Hydro Projected System Plan, the most probable earliest in-service date of the Liard project is 1993. However, this date is subject to further changes depending on future energy demand forecasts and related projections.

The following summarizes the main areas of investigation in this study:

1. Impacts on population, employment and income in the study region.

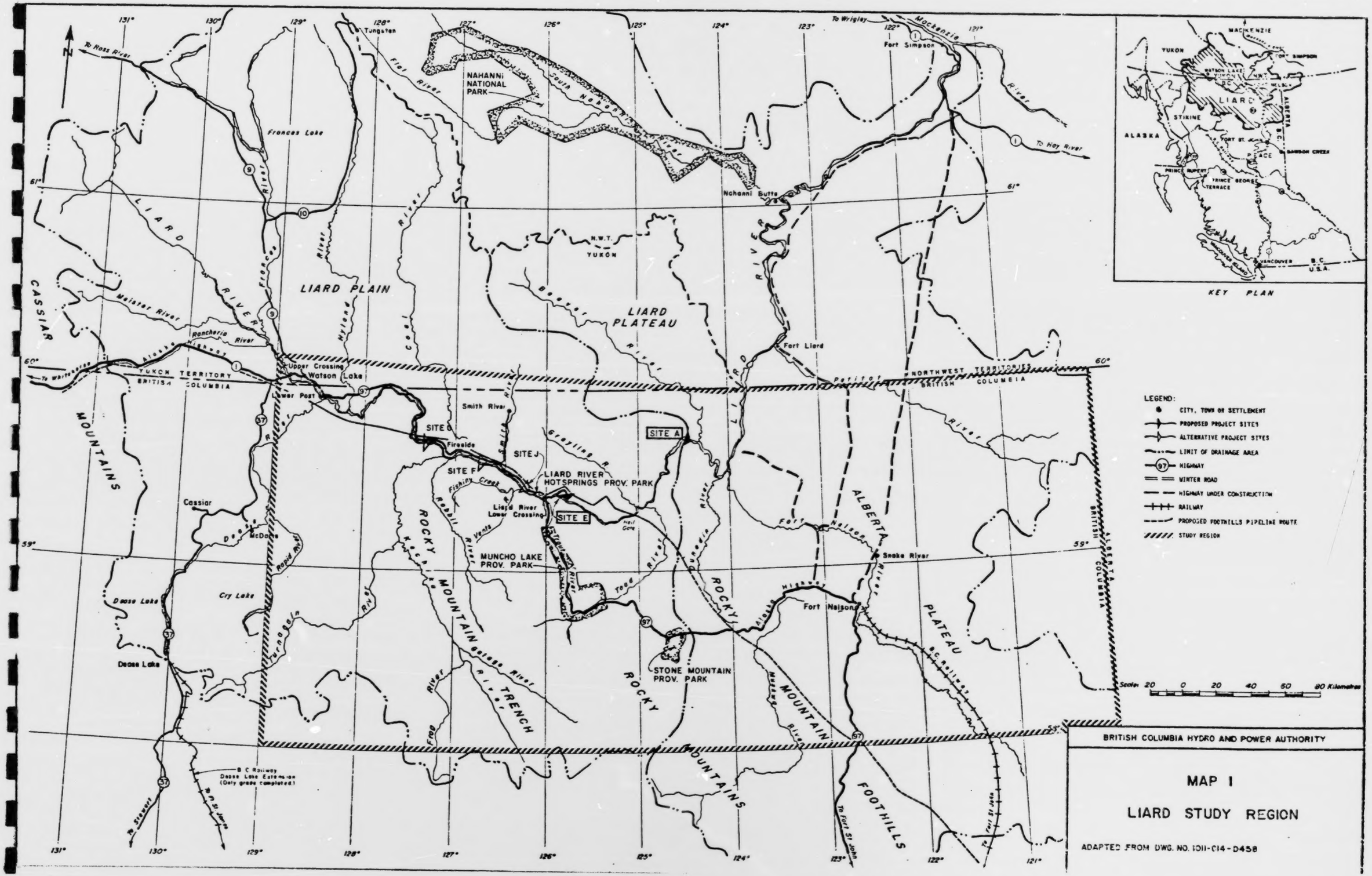
2. Impacts on regional infrastructure.

3. Impacts on community development.

The study area (Map 1) for this analysis is generally defined as the Liard River basin composed of two parts:

1. The Liard Region in B.C. which is equivalent to the School District of Fort Nelson, encompassing the whole northeast corner of the province, north of latitude 58°N, and

2. That portion of the Liard basin in the Yukon Territory which includes Watson Lake and its immediate surroundings.


To Ross River
To Tungsten
To Wrigley
Mackenzie
Fort Simpson
Fort Liard
Nahanni Butte
NAHANNI NATIONAL PARK
South Nahanni River
Flat River
Frances Lake
Frances River
Liard River
To Hay River
LIARD PLAIN
LIARD PLATEAU
N.W.T.
YUKON
Beaver River
Petitot River
Hyland River
Coal River
Meister River
Rancheria River
Alaska Highway
Upper Crossing
Watson Lake
Lower Post
YUKON TERRITORY
BRITISH COLUMBIA
NORTHWEST TERRITORIES
CASSIAR MOUNTAINS
Smith River
SITE G
Fireside
SITE J
SITE F
SITE A
SITE E
Grayling R.
LIARD RIVER HOTSPRINGS PROV. PARK
Fishing Creek
Rabbit River
Vents
Liard River Lower Crossing
Hail Gate
Cassiar
Dease
McDame
Rapid River
Dease Lake
Cry Lake
Turnagain River
MUNCHO LAKE PROV. PARK
Toad River
ROCKY MOUNTAIN TRENCH
Kechika River
Frog River
Gataga River
STONE MOUNTAIN PROV. PARK
ROCKY MOUNTAINS
Muskwa River
Fort Nelson
Snake River
Fort Nelson River
ALBERTA
BRITISH COLUMBIA
PLATEAU
FOOTHILLS
Alaska Highway
To Stewart
To Fort St. John
B.C. Railway
Dease Lake Extension
(Only grade completed)
KEY PLAN
MACKENZIE
YUKON
STIKINE
ALASKA
LIARD
PEACE
DAWSON CREEK
PRINCE RUPERT
PRINCE GEORGE
TERRACE
VANCOUVER
VANCOUVER ISLAND
B.C.
U.S.A.
LEGEND:
CITY, TOWN OR SETTLEMENT
PROPOSED PROJECT SITES
ALTERNATIVE PROJECT SITES
LIMIT OF DRAINAGE AREA
HIGHWAY
WINTER ROAD
HIGHWAY UNDER CONSTRUCTION
RAILWAY
PROPOSED FOOTHILLS PIPELINE ROUTE
STUDY REGION
Scale: 20 0 20 40 60 80 Kilometres
BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
MAP 1
LIARD STUDY REGION
ADAPTED FROM DWG. NO. 1011-C14-D458

1.1 OBJECTIVE OF STUDY - (Cont'd)

Areas downstream of the proposed reservoir in the Northwest Territories are not included in this study because a separate downstream impact study will be conducted at a later date.

The four alternative Schemes are:

1. Scheme 2 with two dams: Site E (El. 571.5) 25 km downstream from Lower Liard Crossing; Site A (El. 390) 100 km upstream from the B.C. - N.W.T. border.

2. Scheme 7 with three dams: Site G (El. 625) 25 km upstream from Fireside; Site F (El. 503) 10 km downstream from Coal River, Site A (El. 445) 100 km upstream from the B.C. -N.W.T. border.

3. Scheme 7A: similar to Scheme 7 except that Site G Dam has a lower elevation (610 m).

4. Scheme 8: similar to Scheme 7 except that Site G Dam has a still lower elevation (572 m), flooding up to the same level as Site E Dam in Scheme 2.

Results of the socio-economic impact analysis will be integrated into the overall cost-benefit assessment of the Liard project in the final stage of the Environmental Impact Assessment.

The next section begins with a description of the existing socio-economic environment of the study region. A forecast of the future socio-economic environment of the study region without the project follows, in the third section. The fourth section provides four scenarios for the study region based on the projected social and economic impacts of the proposed Liard project under the four alternative schemes of development.

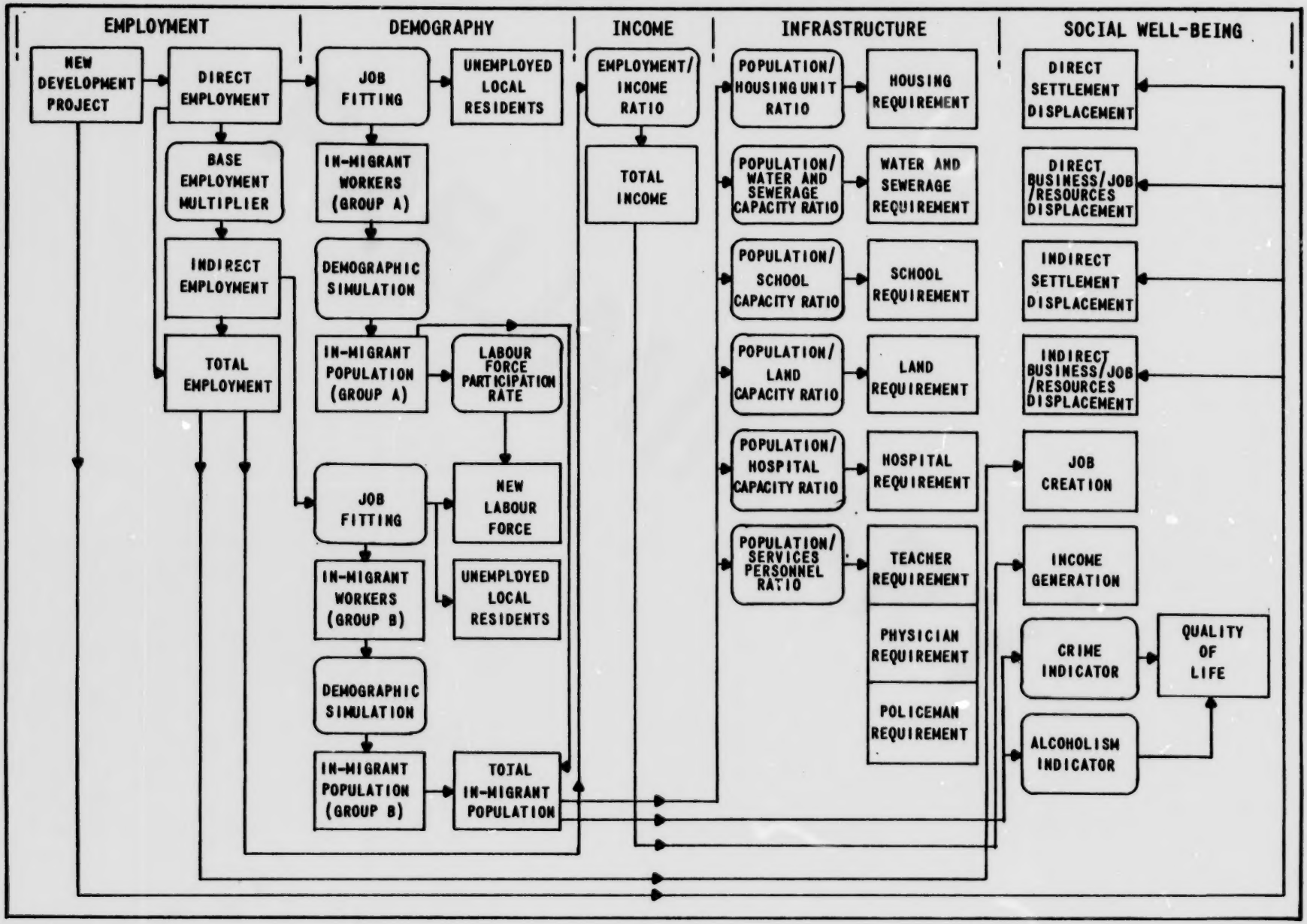
1.2 METHODOLOGY

The approach of impact forecasting can be summarised as follows. Based on projected labour force requirements resulting directly and indirectly from the Liard hydroelectric project, for both short-term temporary construction and long-term permanent operation, the new socio-demographic structure of the study region is predicted, taking into account in-migration patterns. Then, both income generated by increases in employment and demand for social and community services and facilities resulting from in-migration are determined. To the extent possible, social well-being of the communities with the new socio-demographic structures is measured using standard social indicators as criteria. The choice of various forecasting models employed in the analysis will be discussed within individual sections that follow. Figure 1 diagrammatically explains the impact analysis approach.

At this preliminary stage of investigation, most socio-economic data are derived from secondary sources. Since pertinent data are not always available from such sources, the analysis is far from comprehensive and should be viewed as a cursory attempt to identify potential impacts of the proposed Liard project. The scenarios resulting from this analysis are grounded on many assumptions with respect to timing of project construction, labour force requirements and distribution, relationship between direct and indirect employment and income, future developments of the study region without the project and in-migration patterns of the labour force. Although the assumptions were made with the best available knowledge on these crucial factors at the present time, they are subject to change as these factors change.

Compensation and mitigation issues will not be discussed in this report. These will be examined at the final stage of overall impact assessment.

FIGURE I SOCIO-ECONOMIC IMPACT ANALYSIS MODEL



SECTION 2.0 - EXISTING SOCIO-ECONOMIC ENVIRONMENT OF THE LIARD REGION

2.1 DEMOGRAPHY

All the proposed dam sites of the Liard hydroelectric project are located within the B.C. portion of the Liard River. Although areas both upstream and downstream from the B.C. section of the Liard River would experience some impacts from the project, to a large extent the socio-economic impacts would be confined to the B.C. portion of the study region. This area, comprising the Fort Nelson School District, will be referred to as the Fort Nelson Region throughout the report. The area upstream in the Yukon Territory comprising Watson Lake and vicinity will be referred to as the Watson Lake Region in this report.

(a) Fort Nelson Region

The census population of the Fort Nelson Region in 1976 was 4410 representing only 0.2 percent of the total provincial population of 2 465 810. The regional population increase since 1966 was 105 percent, three times as fast as the provincial increase of 35 percent. The rapid growth was largely due to the increased activities in the resource development sector in the region, primarily around the Village of Fort Nelson. Table 2-1 shows the historic growth pattern of the region since 1966. As indicated in the table, virtually all growth has occurred in the Village. The percentage proportion of the Village's population to the regional population has increased from 44 percent in 1966 to 66 percent in 1976 and to 76 percent (estimated) in 1979. Within this period, population in the hinterland has remained virtually unchanged. Table 2-2 shows the distribution of the population within the region for 1979. Although 76 percent of the region's population reside in the Village itself, another 18 percent live on the immediate fringe of the Village, leaving only 6 percent of the regional population to the hinterland.

TABLE 2-1

LIARD STUDY REGION POPULATION, 1966-1979

	Fort Nelson Region			Watson Lake Region		
Year	Village	Fringe and Hinterland	Total	Watson Lake and Airport	Upper Liard	Total
1966[1]	954	1192	2146	554	148	702
1971[1]	2289	1521	3810	642	219	861
1976[1]	2916	1494	4410	882	106	988
1979[2]	3850	1185	5035	1230	190	1420

[1] Source: Statistics Canada, 1966, 1971, 1976. Population Census.

[2] Source: Estimation. For individual sources, see Table 2-2.

TABLE 2-2

ESTIMATED POPULATION OF LIARD SETTLEMENTS, 1979

B.C. Settlement	1979 Population Estimate
Fort Nelson Village	3850
Fort Nelson Fringe	920
Steamboat Mountain	5
Km 604 (Mile 375)	10
Summit Lake	15
Rocky Mountain	10
Toad River	15
Km 689 (Mile 428)	5
Km 699 (Mile 434)	5
Muncho Lake	10
Km 744 (Mile 462)	10
Lower Liard Crossing	10
Coal River	5
Fireside	15
Lower Post	150
TOTAL	5035
Yukon Settlement	
Contact Creek	5
Irons Creek	5
Watson Lake and Airport	1230
Upper Liard	190
TOTAL	1430

Source:

B.C. Settlements - All estimates except for the Village of Fort Nelson and Lower Post are based on a field observation conducted in November of 1979 by B.C. Hydro, Environmental and Socio-economic Services Department. Population estimate of the Village of Fort Nelson is provided by D.F.H. Hollmann, Fort Nelson Consultant Planner (1979a,b). Population of Lower Post as of November 1979 is supplied by J. Langston, Lower Post Elementary School Principal.

Yukon Settlements - Population estimates of Contact Creek, Irons Creek and Watson Lake plus the airport area are based on the same field observation as mentioned above. Population estimate of Upper Liard is supplied by the Government of the Yukon Territory, Economic and Research Unit (1980), based on the Yukon Health Care Records.

2.1 DEOMGRAPHY - (Cont'd)

Within the hinterland Lower Post is the only settlement with a population of more than 100. Most settlements in the hinterland exist as service centres on the Alaska Highway, stretching over a distance of 530 km, between the Village of Fort Nelson and the B.C.-Yukon border (see Map 1).

Lower Post is at Alaska Highway km 998 (Mile 620), 9 km south of the Yukon border. 90 percent of the population are native Indians who are members of the Liard River Indian Band. The band has other members residing in Upper Liard in the Yukon Territory, approximately 30 km northeast on the highway from Lower Post. Population in Lower Post fluctuates over the years. 1971 and 1976 census counts are 206, 146, respectively. The recent 1979 estimate is 150 (Langston, pers. comm.). The settlement is partially situated on the Liard River Band reserve of 217 ha.

Some settlements between Alaska Highway km 798 (Mile 496) and Lower Post are within the proposed reservoir area. These include Lower Liard Crossing (10), Coal River (5) and Fireside (15). Population totals 30.

The Alaska Highway serves as a vital transportation link among these settlements, and between the Fort Nelson Region and southern Yukon. Although the Village of Fort Nelson is located outside the proposed reservoir area, and is at least 300 km from the various proposed dam sites, its importance as a regional service centre means that the Village would be subject to potential impacts generated by the Liard project.

(b) Watson Lake Region

Population in the Yukon side of the Liard basin is located mainly in Watson Lake and Upper Liard, 1230 and 190 respectively. Two small highway service centres, Irons Creek and

2.1 DEMOGRAPHY - (Cont'd)

Contact Creek (total population of 10), are located downstream of Lower Post but fall within the Yukon Territory. These service centres and Upper Liard are all within or very close to the proposed reservoir area of Scheme 7 or 7A of the Liard project.

Upper Liard is a Liard Indian Band settlement. Although the settlement is part of the same band occupying Lower Post in B.C., the two groups are divided by the border and by divisions in the band itself. As in Lower Post, population in Upper Liard has fluctuated over the years. It was 148 in 1966, 219 in 1971, 106 in 1976, and the recent 1979 estimate (Government of the Yukon Territory, 1980) is 190.

Watson Lake, located at Alaska Highway km 1022 (Mile 632), is only about 10 km from the B.C. border, and 130 km from Site G, the closest of all proposed dam sites. Because the town is not located near the Liard River, it would not be directly affected by the project. Population reported in the 1976 census had increased 59 percent since 1966, from 554 to 882. The 1979 estimate of 1230 suggests still faster growth. Compared to that of the Yukon Territory as a whole, the growth rate in Watson Lake is three times faster. Such rapid growth is due to the increasing importance of Watson Lake as a regional transportation and distribution centre. Also, increasing activity in the resource sector has contributed to this rapid growth.

2.2 ECONOMIC BASE

(a) Fort Nelson Region

The strength of the Fort Nelson Region's economy lies mainly in the forest sector and in local petroleum and natural gas resources. The expansion of the economy in these sectors in recent years means increasing demands on the dominant transportation, construction and service industries in the region. The

combined employment of these sectors represents more than 60 percent of the region's experienced labour force in 1971. By comparison, employment in these sectors represents only 46 percent of the province's labour force (Table 2-3). Thus, the relative importance of mining, oil and gas industry, construction and transportation as sources of employment is much greater in the Fort Nelson Region than in the province as a whole. On the other hand, the region's manufacturing, trade and service sectors are relatively less developed when compared to the province.

As mentioned before, the Village of Fort Nelson is the largest settlement centre in the Liard Region. The 94 percent concentration of the region's population in the Village reflects the centralization of economic activities as well. There are currently three sawmills and two veneer plants in the Village and its vicinity, employing approximately 275 to 300 people year round, plus 200 more during peak winter season (Hollmann, 1979c). Other large employers include Westcoast Transmission and several oil and gas exploration enterprises with 200 employees year-round and 1200 in winter on rigs and seismic jobs. In the transportation sector, Canadian National Telecommunications and B.C. Railway are the major employers, with about 100 employees. The major service sector employers are the Village of Fort Nelson, the Hospital, the School Board, the banks and B.C. Hydro. This sector employs about 280 people. Table 2-4 shows the distribution of labour force in Fort Nelson by major employer. All these major employers are located in the Village of Fort Nelson.

In terms of the relationship between the basic and the nonbasic employment sectors of the economy, Fort Nelson has shown increasing strength in the nonbasic sector. In 1974, it was estimated that the basic/nonbasic ratio was 1.0:0.7 (B.C. Ministry

TABLE 2-3

EXPERIENCED LABOUR FORCE BY INDUSTRY, FORT NELSON REGION AND BRITISH COLUMBIA, 1971

Industry	Fort Nelson Region		British Columbia
	Number	Percentage Distribution	Percentage Distribution
Agriculture	5	0.3	2.8
Forestry	30	1.9	3.0
Fishing and Trapping	5	0.3	-
Mining, Oil and Gas	65	4.1	1.6
Manufacturing	60	3.8	15.7
Construction	265	16.8	6.7
Transportation and Communication	295	18.7	9.3
Trade	185	11.7	16.1
Finance, Insurance and Real Estate	25	1.6	4.6
Service	345	21.8	25.4
Public Administration	225	14.2	8.8
TOTAL	1580	99.9	100.0

Source: Statistics Canada, 1971 Census.

TABLE 2-4

LABOUR FORCE BY MAJOR EMPLOYER, FORT NELSON, 1978

Employer	Year Round Employment	Seasonal
Tackama Forest Products	180	200
Fort Nelson Forest Industries	170	150
Fort Nelson School Board	106	-
Westcoast Transmission Ltd.	101	-
Fort Nelson General Hospital	65	-
Village of Fort Nelson	56	-
B.C. Railway	54	-
Canadian National Telecommunications	45	15
B.C. Hydro	24	-
Bank of Commerce	19	-
Bank of Nova Scotia	13	-
Pacific Petroleum	7	-
TOTAL	840	365

Source: Peace-Liard Regional Economic Development Commission, 1979.

of Economic Development, 1975). In 1978, there were 650 year-round jobs in the basic sector which generate 760 nonbasic jobs, indicating a relationship of 1.0 to 1.1 (Table 2-5). However, not all nonbasic employment is generated by the year-round basic jobs. Fort Nelson employs a labour force of about 2000 on seasonal terms. This occurs primarily in the winter operations of oil and gas exploration and forestry. Although most of these in-migrant workers are accommodated by self-contained camps, the occasional visits made to the Village by these workers generate some demands on the service sector. Thus, taking into account the effect of seasonal employment, it is estimated that 1.0 : 0.8 would be a more realistic basic/nonbasic employment ratio.

By occupational group, male labour force in Fort Nelson is heavily represented in construction, transportation and machining, while female labour force is heavily represented in clerical and service (Table 2-6). By comparison, managerial personnel and professionals are the smallest occupational groups in the local economy.

Table 2-7 compares labour force participation rates among Fort Nelson, the Peace River-Liard Region and the province as a whole. Fort Nelson's labour force participation rate in 1971 was substantially higher than B.C. as a whole (28 percent higher). Female rates are even considerably higher (41 percent). Compared to the Peace River-Liard Region, Fort Nelson's labour force participation rate is 16 percent higher. The trend for the province as a whole is for growth in the female participation rate. It has grown from 0.37 in 1971 to 0.46 in 1976. It is expected that the trend for Fort Nelson would not deviate substantially from the province, and its labour force participation rate would continue to be among the highest in the province. This means that as the population and the economy of the Village grow, so will the participation rate of females in the labour force.

TABLE 2-5

EMPLOYMENT BY ECONOMIC ACTIVITY, FORT NELSON, 1978, 1979

Economic Sector	1978	1979
Basic Sector		
Forest Industry	350 + 200 seasonal	275 to 300 + 200 seasonal
Westcoast Transmission	100	100
Oil and Gas Exploration	100 + 1200 seasonal	100 + 1200 seasonal
Tourism	100 + 100 seasonal	100 + 100 seasonal
TOTAL	650 + 1500 seasonal	575 to 600 + 1500 seasonal
Non-basic Sector		
Retail	115	
Government	168	
Schools	106	
Hospital	65	
Insurance/Real Estate	6	
Utilities	73	
Transportation	100	
Service Station/Garages	34	
Professions	21	
Trucking	51	
Contractors	21	
TOTAL	760	

Source: Hollmann, 1979c.

TABLE 2-6

PERCENTAGE DISTRIBUTION OF LABOUR FORCE
BY OCCUPATION, FORT NELSON, 1971

Occupational Group	Percentage	
	Male	Female
Clerical	5.4	40.0
Service	9.3	30.0
Construction	22.5	-
Transport	13.9	-
Machining	11.6	-
Sales	7.8	1.7
Teaching	0.8	8.3
Primary	3.9	-
Medicine	0.8	3.3
Technical	3.1	-
Processing	0.8	-
Managerial	0.8	-
Other	19.3	16.7

Source: Statistics Canada - User Summary Tapes, 1971 Census.

TABLE 2-7

LABOUR FORCE PARTICIPATION RATES, FORT NELSON, PEACE RIVER-LIARD REGION AND BRITISH COLUMBIA, 1971, 1976

	Male	Female	Male and Female
Fort Nelson, 1971	.91	.52	.73
Peace River-Liard Region, 1971	.82	.41	.63
British Columbia, 1971	.78	.37	.57
1976	.78	.46	.62

Source: Statistics Canada, User Summary Tapes, 1971 and 1976 Census.

2.2 ECONOMIC BASE - (Cont'd)

It is estimated that the 1979 labour force in the Fort Nelson Region was 3385 (B.C. Research, 1979), and the estimated number of people unemployed, defined as those seeking for jobs and have registered with the local Canada Manpower Centre, averaged 223 (Table 2-8). Thus, the unemployment rate is estimated at 6.6 percent, as compared to 8.3 percent in B.C. (B.C. Ministry of Economic Development, 1979). The seasonal fluctuation in the number of unemployed in the region, as evident from Table 2-8, suggests that highest unemployment is found in the winter season when job demand out-numbers job supply - this is because the winter labour force is often substantially augmented by an increase in job seekers from outside the region, who are attracted by the increased activity in the oil and gas exploration industries. This pattern is supported by statistics on unemployment insurance recipients, as presented in Table 2-9. This table also gives a breakdown of the data by occupation. Those in the service, clerical and construction occupational groups represent more than 60 percent of all registrants, and the number is much higher in the winter months. These observed fluctuations reflect the cyclical nature of the regional economy. Some employment in such sectors as forestry, mining, construction and tourism are for part of the year only. Persons employed in these sectors often experience difficulty finding supplementary employment in other sectors during lay-off periods, due to a lack of available jobs or lack of skills. Also, scarcity of traditionally female dominated jobs - service and clerical - plus increasing female participation in the labour force suggests that there will be higher unemployment rates in the female work force, unless incentives are provided to attract women to participate in non-traditional female jobs such as mining, construction and the like.

Outside the Village of Fort Nelson, the Fort Nelson Indian Band settlement is located 8 km south of the Village on the

TABLE 2-8

NUMBER OF REGISTRANTS WITHOUT EMPLOYMENT,
FORT NELSON REGION, 1975-1978, BY MONTH

Month	1975	1976	1977	1978
January	206	223	172	325
February	192	199	157	236
March	179	241	207	297
April	174	196	204	303
May	166	213	199	304
June	97	173	219	217
July	103	146	156	194
August	115	94	146	137
September	147	125	128	184
October	127	127	118	203
November	155	175	252	200
December	195	135	273	133
ANNUAL AVERAGE	155	171	186	223

Source: Greer, 1980. Canada Manpower Centre, Fort Nelson Branch.

Notes: High numbers in early 1978 are indicative of the Tackama Sawmill fire and the uncertainty as whether the B.C. Railway would continue operation.

Based on the average increase rate on the annual average number of registrants between 1975 and 1977, it is postulated that the number of registrants in 1979 is 223.

TABLE 2-9

NUMBER OF PERSONS RECEIVING UNEMPLOYMENT INSURANCE BENEFITS, FORT NELSON REGION AND WATSON LAKE REGION, 1979, BY QUARTER YEAR

Occupation	Fort Nelson Region					Watson Lake Region					Average Total
	Feb	May	Aug	Nov	Avg	Feb	May	Aug	Nov	Avg	
Managerial	0	0	1	2	1	2	1	0	2	1	2
Sciences	1	1	1	3	2	2	1	0	0	1	3
Social Sciences	3	4	5	3	4	0	0	1	1	1	5
Teaching	4	5	3	1	3	0	0	4	2	2	5
Medicine	2	6	5	2	4	2	1	0	1	1	5
Recreation	1	1	0	1	1	3	4	2	1	3	4
Clerical	18	23	17	14	18	13	13	3	3	8	26
Sales	6	7	7	4	6	0	0	0	1	0	6
Service	34	29	17	19	25	26	21	17	8	18	43
Farming	1	0	0	0	0	0	0	0	0	0	0
Processing	9	9	4	5	7	6	2	2	1	3	10
Machining	1	3	1	1	2	1	0	0	0	0	2
Fabricating	4	2	1	4	3	3	2	1	3	2	5
Construction	41	25	8	12	22	16	10	4	4	9	21
Transport	3	7	4	2	4	5	3	2	1	3	7
Mat. Handling	1	1	1	0	1	0	1	0	0	0	1
Forestry	0	3	3	0	2	1	2	1	3	2	4
Mining	0	1	0	0	0	2	2	1	0	1	1
Other	3	2	2	0	2	18	19	9	4	13	15
Total	132	129	80	73	107	100	82	47	35	68	175

Source: Unemployment Insurance Commission, Vancouver, 1980. Statistics do not include persons not available for work due to sickness or disability, nor those receiving maternity benefits.

Alaska Highway. The Fort Nelson Band has 300 members of whom 66 percent live on the reserve (Department of Indian Affairs, 1975). The reserve contains several gas wells and some pipelines from which the band receive royalties. Although no statistics are available on the number of Indians employed either on the reserve or in other industries, it is generally felt that any band members who want to work can find work in the area.

The economy in the hinterland of the Fort Nelson Region is sustained by the Alaska Highway. A typical hinterland settlement consists of a cafe-gas station-lodge, run as a family business, and occasionally a few residential dwelling units. Highway maintenance camps are scattered along the highway providing sources of employment.

In Lower Post, the only business is a non-Indian run hotel-cafe plus a gas station. Wage employment of Indians is not known.

In a recent government study on Northeast coal development, it was pointed out that fully one-third of the Indian population over 15 in the Northeast had no income at all, and for almost one-fourth of the population with income the major source was transfer payments from government. Furthermore, the study points out that unemployment among registered Indians stands at over 50 percent in 1976 (B.C. Ministry of Economic Development, 1976). Although these findings refer to the North East as a whole, it is believed that such generalization is not unreasonable for Lower Post.

Lower Post Indians who are employed with the native organizations work in Watson Lake where the Liard Indian Band office is located. In 1976, it is estimated that the Band Office

employed 16 Indians who are from both Lower Post and Upper Liard. Commercial trapping for export is relatively unimportant, judging from the income of $8000 to $12 000 per year generated by pelt export in the Watson Lake area, including Lower Post and Upper Liard (Government of the Yukon Territory, Economic Research and Planning Unit, 1978).

Average personal income in the region is observed to be lower than both the provincial average and the Greater Vancouver average (Table 2-10), in spite of higher cost of living in the region. It has been estimated that Fort Nelson's cost of living is 20 to 30 percent higher than Vancouver (Associated Resource Consultants, 1978).

(b) Watson Lake Region

Information on employment in the Watson Lake Region is less readily available, primarily because most quantitative data are not regularly collected or calculated on a regional or community basis for the Yukon Territory.

Although the region consists of three settlements, the Watson Lake Local Improvement District (LID), the Airport Settlement and Upper Liard, the three are often considered as one community and collectively referred to as Watson Lake. This is due to their proximity to each other and to the fact that the latter two belong to the local economy of the large LID settlement.

Watson Lake historically was a fishing area for the Upper Liard Kaska Indians. It has evolved into a regional transportation centre, supporting the airport and the Alaska Highway transportation system. Since 1960, due to an upsurge in mining activity, expansion of Yukon's forest industry and, until recently, increasing tourist traffic along the Alaska Highway, population has grown at a steady pace, and faster than the Yukon

TABLE 2-10

AVERAGE PERSONAL INCOME - FORT NELSON INCLUDING CENSUS SUBDIVISION A, GREATER VANCOUVER AND BRITISH COLUMBIA, 1976 AND 1977

1976	Fort Nelson Region	Greater Vancouver	British Columbia
Number of Income Tax Returns	3 019	651 624	1 361 351
Total Income ($000s)	32 274	7 394 687	15 126 950
Average Income ($)	10 690	11 348	11 111
1977			
Number of Income Tax Returns	3 323	666 037	1 400 830
Total Income ($000s)	39 326	8 101 498	16 711 865
Average Income ($)	11 834	12 164	11 929

Source: B.C. Ministry of Economic Development, Central Statistics Bureau. Unpublished data compiled from the universe master file of Revenue Canada, 1979.

Territory as a whole. Although there are no statistics available on the employment pattern of the region, the distribution of employment among major economic sectors can be inferred by noting the major types of employers. Watson Lake's economy is stated as diversified and unlike many northern resource towns with single industries, it is not threatened with extinction by the closure of its largest industry (Government of the Yukon Territory, Economic Research and Planning Unit, 1978).

The basic employment sector consists of forestry, mining, and local construction. Currently there are four sawmills in operation, employing 45 full-time and 25 part-time workers. Although there are no mining operations within the immediate area of Watson Lake, the three producing mines within a 200 mile radius have contributed indirectly to the local economy by generating demands on the transportation, communication and merchandising sectors. Similarly, major construction projects such as reconstruction and paving of the Stewart-Cassiar Highway, upgrading of the nearby sections of the Alaska Highway and construction in the mining sector, have indirectly affected transportation services, lumber, accommodation and other service oriented industries in the local economy.

Nonbasic employment in the region is largely provided by transportation, tourism, government and services. In the transportation sector, Watson Lake's trucking industry is the third largest in the territory, serving all of southeast Yukon and north-central B.C. The nearby airport has the highest increase in the volume of aircraft and passenger movements among commercial airports in northern B.C. and Yukon in recent years. The increase ties in closely with activities in mining.

Tourism represents an important source of income to the local economy, approximately $660 000 in 1977 (Government of

the Yukon Territory, Economic Research and Planning Unit, 1978) which was 17.7 percent of Yukon's total tourist industry income for that year. The industry, however, depends upon through flow traffic of visitors, as few tourist attractions exist to draw and keep visitors in the community itself. This suggests that the industry is very sensitive to any change in the volume of visitor traffic through the area.

Government is another major employer of the local economy. In 1976 it was recorded that 212 people were employed in various government agencies. This represents over half of the total 405 people employed in the community (Government of the Yukon Territory, Economic Research and Planning Unit, 1978).

In the service sector, Watson Lake has the second largest number of retail outlets in the territory, approximately 31, suggesting a sizeable employment when compared to other sectors of the local economy.

It is estimated that the population over 14 years of age in the Watson Lake Region in 1976 was 774. Thus, total local employment of 405 people represents 52 percent of this labour force.

In 1979, there were 68 people receiving unemployment insurance benefits in the Watson Lake Region (Table 2-9). The 1979 population estimate for the region indicates that there were 1065 people in the labour force, i.e., people over age 14 (Government of the Yukon Territory, 1980). Thus, the unemployment insurance benefits recipients represented 6.4 percent of the regional labour force.

The wage employment pattern in Upper Liard is little known. Other than the local hotel-cafe-store, all facilities and services are administered from Watson Lake.

SECTION 3.0 - PROJECTION OF THE SOCIO-ECONOMIC ENVIRONMENT OF THE LIARD REGION WITHOUT THE LIARD RIVER PROJECT

The purpose of providing a "without project" scenario for the future of the Liard Region is to facilitate comparison of alternative development possibilities, including the possibility that the Liard project would not proceed. This is to ensure that only net benefits or costs would be ascribed to the project.

The forecasting model involves four steps. First, population projections for the study region under natural growth conditions are established. Such population projections are available from the various provincial and territorial governments. Secondly, utilizing available government reports, personal discussions and other sources, estimates are compiled of employment growth or decline in the basic sectors of the economy. Then, induced growth or induced decline in the nonbasic sectors is estimated using appropriate regional base multipliers. The final step involves projecting population change from in-migration or out-migration resulting from the change in total regional employment.

The projection is for the next 21-year period, from 1980 to 2001. The 21-year projection period would adequately take into account both the construction phase and a few years of the operation phase of the Liard project, and it will end in a census year.

As cautioned in the Introductory chapter, the projection estimates should not be taken to be precise and perfectly reliable measures of the future changes in the Liard Region. Many assumptions and parameters of measurement are still at their crudest stage of development. Rather, these preliminary projections are to serve as indicators of the general direction of the changes that may occur in the region.

3.1 POPULATION GROWTH AT NATURAL GROWTH RATES

Table 3-1 presents the population projections by sub-region within the Liard study region, and by year for the period of 1980 to 2001, under natural rates of growth. These projections are provided by the Government of Yukon for the Watson Lake Region and B.C. Research for the Fort Nelson Region. B.C. Research adopted the cohort survival model for their projections. Projections provided by the Government of Yukon are based on a linear projection method using an annual growth rate of 3.4 percent. This rate is the overall average annual growth rate of the Yukon Territory since 1971.

The projections suggest that under normal rates of growth in the Liard Region, by the year 1990, the regional population would increase by 38 percent, and by 82 percent by the year 2001. By comparison, Watson Lake is faster growing than Fort Nelson. Its population would more than double by the year 2001. Whereas, Fort Nelson Region would increase its population by 38 percent by 1990, and by slightly less than three-quarters by 2001.

3.2 PROJECTIONS IN REGIONAL EMPLOYMENT

The North East study prepared by the B.C. Ministry of Economic Development (1975) is the most recent study on future development possibilities in the Fort Nelson Region. In the summary report of the study, it is predicted that Fort Nelson would experience slight employment increases over the next 5 years due to expansions in the forest industries. However, in the long-run, the diminishing oil and gas resources in the region is expected to slow down the local economy. Table 3-2 summarizes this scenario. It is estimated that 35 new net basic jobs, primarily in the forest sector, would be added to the economy between 1980 and 1984. The slow-down period would begin in 1985. Between 1986 and 2001, there would be a net reduction of 175 to 105 basic jobs, primarily in the oil and gas sector.

TABLE 3-1

POPULATION PROJECTIONS FOR THE LIARD REGION
AT NATURAL GROWTH RATES, 1980-2001

Year	Fort Nelson[1]	Watson Lake[2]	Total
1980	5262	1448	6 710
1981	5492	1497	6 989
1982	5706	1548	7 254
1983	5918	1600	7 518
1984	6127	1655	7 782
1985	6332	1711	8 043
1986	6532	1769	8 301
1987	6713	1829	8 542
1988	6894	1891	8 785
1989	7075	1956	9 031
1990	7256	2022	9 278
1991	7440	2162	9 602
1992	7609	2235	9 844
1993	7778	2312	10 090
1994	7947	2472	10 419
1995	8116	2556	10 672
1996	8283	2643	10 926
1997	8449	2733	11 182
1998	8615	2826	11 441
1999	8781	2922	11 703
2000	8947	3021	11 968
2001	9116	3124	12 240

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1 Includes Village of Fort Nelson, Fireside, Lower Post and the remainder of School District 81.

Source: B.C. Research, 1979. British Columbia Population Projections 1979-2001, Vancouver, B.C.

2 Includes Watson Lake, the Airport and Upper Liard.

Source: Government of the Yukon Territory, Economic Research and Planning Unit, 1978. The Economic Potential of the Watson Lake Region, Whitehorse, Y.T.

TABLE 3-2

NET EMPLOYMENT CHANGES IN THE LIARD REGION WITHOUT THE LIARD PROJECT, 1980-2001

	Fort Nelson Region					Watson Lake Region				
	Basic Employment		Nonbasic Employment			Basic Employment		Nonbasic Employment		
Year	Pipeline[1]	Other Sectors[2]	Pipeline[1]	Other Sectors[2]	Total Employment	Pipeline[1]	Other Sectors[3]	Pipeline[1]	Other Sectors[3]	Total Employment
1980	-	35	-	28	63	-	9	-	33	42
1981	-	35	-	28	63	-	19	-	38	57
1982	-	35	-	28	63	-	19	-	38	57
1983	360	35	190	28	613	-	34	-	46	80
1984	1900	35	795	28	2758	-	33	-	42	75
1985	1500	-	590	-	2090	-	33	18	42	93
1986	29	-175	24	-140	-262	19	44	16	81	160
1987	29	-175	24	-140	-262	19	55	16	120	210
1988	29	-175	24	-140	-262	19	45	16	81	161
1989	29	-175	24	-140	-262	19	45	16	81	161
1990	29	-175	24	-140	-262	19	35	16	267	337
1991	29	-140	24	-112	-199	19	35	16	267	337
1992	29	-140	24	-112	-199	19	35	16	267	337
1993	29	-140	24	-112	-199	19	35	16	267	337
1994	29	-140	24	-112	-199	19	35	16	267	337
1995	29	-140	24	-112	-199	19	35	16	267	337
1996	29	-105	24	-84	-136	19	35	16	267	337
1997	29	-105	24	-84	-136	19	35	16	267	337
1998	29	-105	24	-84	-136	19	35	16	267	337
1999	29	-105	24	-84	-136	19	35	16	267	337
2000	29	-105	24	-84	-136	19	35	16	267	337
2001	29	-105	24	-84	-136	19	35	16	267	337

[1] Source: Associated Resource Consultants, 1978.

[2] Source: B.C. Ministry of Economic Development. The North East Report, 1975.

[3] Source: Government of Yukon. Economic Research and Planning Unit, the Economic Potential of the Watson Lake Region, 1978.

Note: See Appendix A for derivation of these projections.

3.2 PROJECTIONS IN REGIONAL EMPLOYMENT - (Cont'd)

Changes in basic employment would affect the nonbasic sector. It was noted in the previous section (Section 2.2, p. 2-9) that the basic/nonbasic employment multiplier for the Fort Nelson Region is 1.8. Thus, for every job created in the basic sector, 0.8 jobs would be generated in the nonbasic sector, giving a total of 1.8 jobs in the economy. Or, for every basic job removed, a total of 1.8 jobs would be eliminated. Thus, Fort Nelson Region would gain 28 nonbasic jobs between 1980 and 1984, and lose between 140 and 84 nonbasic jobs in the following 15 years.

However, if the Alaska Highway Gas Pipeline project were to proceed, some new jobs would be addeded to the region. The forecast of direct (basic) Pipeline employment in both the construction phase and the operation phase, as depicted in Table 3-2, is provided by Foothills Pipeline Ltd. (1978). It is assumed that construction of the Fort Nelson section of the pipeline will commence in 1983 and will last for 3 years (Berry, pers. comm.). During the peak employment season, the Pipeline would employ 360 people in the first year of construction, increasing to 1900 in the second year, then declining slightly to 1500 in the third year, for that section of the Pipeline between the B.C.-Yukon border and the Village of Fort Nelson. In the nonbasic sector, a total of 1575 indirect jobs would be created during the construction period, 190 in the first year, 795 and 590 in the second and third years respectively. The operation phase would result in 29 direct (basic) permanent jobs which would induce 24 indirect (nonbasic) jobs through the multiplier effects. These permanent jobs would most likely be located in the Village of Fort Nelson.

Overall, new employment resulting from the pipeline project is not expected to be high enough to offset the employment reduction in other industries, except during the peak construction years. If the assumptions and parameters used in formulating this scenario were

3.2 PROJECTIONS IN REGIONAL EMPLOYMENT - (Cont'd)

accurate, the next 20 years in the Fort Nelson Region would witness an unsteady period of growths and declines.

In the Watson Lake Region, on the other hand, forecast of employment is for steady growth. Although few basic jobs are anticipated to occur within the town of Watson Lake or its immediate surrounding, new developments within the 200-mile radius of the town are expected to induce substantial employment in the nonbasic sector of the local economy. In the study of Economic Potential of the Watson Lake Region prepared by the government of Yukon (1978), it is expected that net new employment will result from increased activities in the forestry, mining and construction industries. These include expansion of both the Y.F.P. Sawmill and the Century Mine, two new sawmills in Lower Post and Watson Lake, and a new mine in Howards Pass. Thus, over the next 20 years, total new employment would increase from 42 jobs to 302 jobs in the non-Pipeline sector.

There would be no Alaska Highway Pipeline construction workforce in Watson Lake as the construction camp would be located on the B.C. side of the border. However, in the operation phase, the Pipeline would require operating staff in Watson Lake on a permanent basis. It is estimated that operation employment in the Watson Lake area would total 19 in the basic sector and 16 in the nonbasic sector.

3.3 POPULATION IMPACTS RESULTING FROM REGIONAL EMPLOYMENT

Forecasts of population changes resulting from employment changes are based on ratios of the two factors derived from other studies.

For the Fort Nelson Region, Pipeline induced population during the construction period can be divided into two groups. Group 1 would be people in-migrating to the region to assume direct construction jobs. Since the duration of Pipeline construction is short and

manpower requirements vary substantially from season to season, these in-migrant workers are not expected to relocate their families to the region. For the purpose of this study, this group of population is assumed all single in-migrants. Group 2 would be people in-migrating to the region to assume indirect jobs during the Pipeline construction period. Since most of these jobs would be in the service sector and be located in the existing population centres rather than in work camps, the in-migrant workers would more likely relocate their families to the region. However, due to the short duration of employment, it is expected that mainly young childless couples would be attracted to relocate, as they are more mobile than older families. For the purpose of this study, this group of in-migrants is assumed to be all 2-person households. Thus, during the peak year of Pipeline construction, population may increase as much as to 3490 persons in the Fort Nelson Region, as a result of 2695 total Pipeline jobs. This is summarized in Tables 3-3 and 3-4.

The operation phase of the Pipeline project would result in a permanent population increase of 138 persons in the Fort Nelson Region. It is assumed that the in-migrant population would have an average household size of 3.37 persons,* which resembles that of the existing population in the region. It is also assumed that 50 percent of the adult females of the housholds would work.**

In the non-Pipeline sector, the North East Study (B.C. Ministry of Economic Development, 1975) predicted a reduction in employment beyond 1985. Thus, out-migration is expected to result. It is estimated that a total of 768 to 464 people would leave the region between 1986 and 2001.

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* This figure is established from a sample survey of the residents of the region conducted in November of 1979 by B.C. Hydro, Environmental and Socio-economic Services Department.

** Currently the female labour force participation rate in Fort Nelson is .52 (see Table 2-7).

TABLE 3-3

ESTIMATED NUMBER OF JOBS TO BE FILLED BY IN-MIGRANTS (WITHOUT THE LIARD PROJECT)
1980-2001

	Fort Nelson Region				Watson Lake Region			
	Basic		Nonbasic		Basic		Nonbasic	
Year	Pipeline[1]	Other[2]	Pipeline[1]	Other[1]	Pipeline[2]	Other[2]	Pipeline[2]	Other[2]
1980	-	32	-	28	-	8	-	30
1981	-	32	-	28	-	17	-	34
1982	-	32	-	28	-	17	-	34
1983	360	32	190	28	-	31	-	41
1984	1900	32	795	28	-	30	-	38
1985	1500	-	590	-	-	30	16	38
1986	29	-158	24	-140	17	40	14	73
1987	29	-158	24	-140	17	50	14	108
1988	29	-158	24	-140	17	41	14	73
1989	29	-158	24	-140	17	41	14	73
1990	29	-158	24	-140	17	32	14	240
1991	29	-126	24	-112	17	32	14	240
1992	29	-126	24	-112	17	32	14	240
1993	29	-126	24	-112	17	32	14	240
1994	29	-126	24	-112	17	32	14	240
1995	29	-126	24	-112	17	32	14	240
1996	29	-95	24	-84	17	32	14	240
1997	29	-95	24	-84	17	32	14	240
1998	29	-95	24	-84	17	32	14	240
1999	29	-95	24	-84	17	32	14	240
2000	29	-95	24	-84	17	32	14	240
2001	29	-95	24	-84	17	32	14	240

[1] 100 percent of the jobs are assumed to be filled by in-migrants.

[2] 90 percent of the jobs are assumed to be filled by in-migrants.

TABLE 3-4

ESTIMATED IN-MIGRANT POPULATION (WITHOUT THE LIARD PROJECT)
1980-2001

	Fort Nelson Region				Watson Lake Region						
	Basic		Nonbasic		Basic		Nonbasic		Total		
Year	Pipeline	Other	Pipeline	Other	Pipeline	Other	Pipeline	Other	Pipeline	Other	Grand Total
1980	-	108	-	47	-	28	-	52	-	235	235
1981	-	108	-	47	-	59	-	59	-	273	273
1982	-	108	-	47	-	59	-	59	-	273	273
1983	360[1]	108	380[2]	47	-	108	-	71	740	334	1074
1984	1900[1]	108	1590[2]	47	-	104	-	66	3490	325	3815
1985	1500[1]	-	1180[2]	-	-	104	56	66	2736	170	2906
1986	98	-532	40	-236	59	139	24	127	221	-502	-281
1987	98	-532	40	-236	59	174	24	187	221	-407	-186
1988	98	-532	40	-236	59	142	24	127	221	-499	-278
1989	98	-532	40	-236	59	142	24	127	221	-499	-278
1990	98	-532	40	-236	59	111	24	416	221	-241	-20
1991	98	-425	40	-189	59	111	24	416	221	-87	134
1992	98	-425	40	-189	59	111	24	416	221	-87	134
1993	98	-425	40	-189	59	111	24	416	221	-87	134
1994	98	-425	40	-189	59	111	24	416	221	-87	134
1995	98	-425	40	-189	59	111	24	416	221	-87	134
1996	98	-320	40	-142	59	111	24	416	221	65	286
1997	98	-320	40	-142	59	111	24	416	221	65	286
1998	98	-320	40	-142	59	111	24	416	221	65	286
1999	98	-320	40	-142	59	111	24	416	221	65	286
2000	98	-320	40	-142	59	111	24	416	221	65	286
2001	98	-320	40	-142	59	111	24	416	221	65	286

Note: It is assumed, that the average family size of Fort Nelson Region is 3.37, and of Watson Lake Region is 3.47, with the following exceptions: [1] 1.00, [2] 2.00.

3.3 POPULATION IMPACTS RESULTING FROM REGIONAL EMPLOYMENT - (Cont'd)

Although the Pipeline project would produce jobs that would attract families to stay in the region on a permanent basis, the overall influence of the project would be weak because, in the long run, job loss in the non-pipeline sector greatly outnumbers job gain in the Pipeline sector. The overall scenario for the Fort Nelson Region without the Liard project, according to all the aforementioned assumptions, is one of population and job decline beginning as of late 1980s, in spite of the Pipeline project.

For the Watson Lake Region, forecasts of population changes are based on the assumption that only 90 percent of all new jobs created in the region would be filled by in-migrants (Government of the Yukon Territory, Economic Research and Planning Unit. 1978). It is also assumed that the in-migrant average household size is 3.47 persons,* same as that of Watson Lake population at large, and that 50 percent of the adult females of the households would work. As depicted in Tables 3-3 and 3-4, the total estimated in-migrant population in the Watson Lake Region would be increasing from 80 persons in 1980 to 610 persons in 2001, the majority of which would be due to new jobs in the non-Pipeline sector.

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* This figure is established from a sample survey of the residents of the region conducted in November of 1979 by B.C. Hydro, Environmental and Socio-economic Services Department.

SECTION 4.0 - PROJECTION OF THE SOCIO-ECONOMIC ENVIRONMENT OF THE LIARD REGION WITH THE LIARD RIVER PROJECT

In this section, the potential regional economic and social impacts resulting from the Liard project for both the construction period and the operation phase are analyzed. The objective is to compare the relative impacts accruing from the four proposed schemes of development, and to compare the "without project" environment to the "with project" environment.

The analysis is generally limited to the Fort Nelson and Watson Lake Regions, as downstream impacts are difficult to forecast at this stage due to the lack of adequate data.

The analysis is preliminary and general. Many potential impact areas are not examined due to the unavailability of appropriate information. A more thorough analysis will be carried out at a later stage.

Timing of the proposed Liard projects is still tentative. The 1979 projected System Plan shows that the earliest achievable in-service dates are 1993 for Site E and 1996 for Site A. Timing of the other schemes is expected to be similar. Since Sites F and G in the alternative schemes are substitutes for Site E, the two dams combined should be ready for service by 1993 at the latest. However, these in-service dates are subject to further changes based on energy demand growth and other projections.

Construction time varies from scheme to scheme, and from project to project. Under Scheme 2, both Site E and Site A would require 9 years for construction. Under Scheme 7, both Site G and Site F would require 7 years for construction, and Site A would require

12 years because Scheme 7 calls for a higher dam at Site A than Scheme 2. Construction time for either Scheme 7A or Scheme 8 is similar to Scheme 7 for Site F and Site A, but for Site G, because of a lower dam, it would only require 6 years to complete.

Construction of the project is staged such that the entire hydroelectric development would require 12 years to complete. This is common to all four schemes. In order to meet the in-service date for the first unit at Site E of 1993, construction would have to commence as early as 1985.

4.1 POPULATION, EMPLOYMENT, INCOME IMPACTS

(a) Direct Employment Impacts: Construction Phase

(i) Manpower Requirements

At this stage, detailed information on skill requirements of the construction work force is not available. Only rough estimates are made. Tables 4-1a, 4-1b, 4-1c and 4-1d give the longitudinal distribution of construction work force for the Liard project for the four alternative schemes of development. The estimates include manpower requirements for reservoir clearing and highway relocation, in addition to reservoir construction.

By comparison, Scheme 7 would have the largest overall work force requirement (21 350 man-years), followed by Scheme 7A (20 750 man-years), then Scheme 2 (18 920 man-years) and Scheme 8 (18 850 man-years). The difference between the highest and the lowest requirements, however, is small. It is less than 13 percent.

Because Scheme 2 involves two dams only, labour force requirements would be lower than Schemes 7

TABLE 4-1a

LIARD PROJECT CONSTRUCTION MANPOWER REQUIREMENTS,
SCHEME 2

	Site E		Site A		Total	
Year	Average	Peak	Average	Peak	Average	Peak
1985	700	1 100			700	1 100
1986	1 200	1 800			1 200	1 800
1987	1 500	2 300			1 500	2 300
1988	1 600	2 300	500	850	2 100	3 150
1989	1 800	2 600	850	1 200	2 650	3 800
1990	2 050	3 000	1 100	1 700	3 150	4 700
1991	1 800	2 600	900	1 300	2 700	3 900
1992	450	650	1 000	1 400	1 450	2 050
1993	120	200	1 200	1 800	1 320	2 000
1994			1 600	2 300	1 600	2 300
1995			400	550	400	550
1996			150	200	150	200
man-years	11 200		7 700		18 920	

Figures represent on-site labour and include reservoir clearing and highway relocation labour force.

Source: Hydroelectric Generation Projects Division, B.C. Hydro. 1980.

TABLE 4-1b

LIARD PROJECT CONSTRUCTION MANPOWER REQUIREMENTS,
SCHEME 7

	Site G		Site F		Site A		Total	
Year	Average	Peak	Average	Peak	Average	Peak	Average	Peak
1985	600	1 000	150	300	500	800	1 250	2 100
1986	650	1 000	300	400	900	1 400	1 850	2 800
1987	800	1 200	600	850	700	1 000	2 100	3 050
1988	1 000	1 500	900	1 200	1 100	1 700	3 000	4 400
1989	1 100	1 600	1 000	1 500	950	1 400	3 050	4 500
1990	1 000	1 400	600	900	1 000	1 400	2 600	3 700
1991	550	800	100	100	1 200	1 700	1 850	2 600
1992					1 500	2 200	1 500	2 200
1993					1 800	2 700	1 800	2 700
1994					1 600	2 300	1 600	2 300
1995					600	800	600	800
1996					150	200	150	200
man-years	5 700		3 650		12 000		21 350	

Figures represent on-site labour and include reservoir clearing and highway relocation labour force.

Source: Hydroelectric Generation Projects Division, B.C. Hydro. 1980.

TABLE 4-1c

LIARD PROJECT CONSTRUCTION MANPOWER REQUIREMENTS,
SCHEME 7A

	Site G		Site F		Site A		Total	
Year	Average	Peak	Average	Peak	Average	Peak	Average	Peak
1985	750	1 200	150	300	500	800	1 400	2 300
1986	1 100	1 700	300	400	900	1 400	2 300	3 500
1987	950	1 400	550	850	700	1 000	2 200	3 250
1988	1 100	1 700	850	1 200	1 100	1 700	3 050	4 600
1989	1 000	1 400	1 000	1 400	900	1 300	2 900	4 100
1990	400	550	600	850	950	1 400	1 950	2 800
1991			100	110	1 200	1 700	1 300	1 810
1992					1 500	2 200	1 500	2 200
1993					1 800	2 600	1 800	2 600
1994					1 600	2 200	1 600	2 200
1995					600	800	600	800
1996					150	200	150	200
man-years	5 300		3 550		11 900		20 750	

Figures represent on-site labour and include reservoir clearing and highway relocation labour force.

Source: Hydroelectric Generation Projects Division, B.C. Hydro. 1980.

TABLE 4-1d

LIARD PROJECT CONSTRUCTION MANPOWER REQUIREMENTS,
SCHEME 8

	Site G		Site F		Site A		Total	
Year	Average	Peak	Average	Peak	Average	Peak	Average	Peak
1985	400	600	150	300	500	850	1 050	1 750
1986	300	450	300	400	900	1 400	1 500	2 250
1987	650	1 000	550	850	700	1 000	1 900	2 850
1988	800	1 200	850	1 200	1 100	1 700	2 750	4 100
1989	1 000	1 400	1 000	1 400	900	1 300	2 900	4 100
1990	300	450	600	850	950	1 400	1 850	2 700
1991			100	100	1 200	1 700	1 300	1 800
1992					1 500	2 200	1 500	2 200
1993					1 800	2 700	1 800	2 700
1994					1 600	2 200	1 600	2 200
1995					600	800	600	800
1996					100	150	100	150
man-years	3 450		3 550		11 850		18 850	

Figures represent on-site labour and include reservoir clearing and highway relocation labour force.

Source: Hydroelectric Generation Projects Division, B.C. Hydro. 1980.

and 7A which require three dams. Scheme 8 has an aggregated labour force almost the same as Scheme 2. Although Scheme 8 has three dams, Site G would have a much lower dam than either Scheme 7 or Scheme 7A. It would flood up to the same level as Scheme 2. Thus, Scheme 8 does not have a labour force requirement as high as either Scheme 7 or Scheme 7A.

All four schemes have a peak year where labour force reaches the highest. They range from the fourth year (Scheme 8) to the sixth year (Scheme 2) of the 12-year period of construction. The peak labour force varies from 4700 persons for Scheme 2 to 4100 persons for Scheme 8. Overall, differences between the schemes are small. Fig. 2 provides a diagrammatic comparison.

(ii) Manpower Supply

Manpower supply is expected to come mainly from in-migration. The assumption is that skilled construction personnel available from within the study region would be limited. For the purpose of this study, jobs created directly from the hydroelectric project would be filled by experienced personnel available for work from within the study region first. Any jobs unfilled by local residents will be filled by in-migrants.

Table 4-2 projects local labour force supply by year. The projection is based on current unemployment statistics. It is assumed that all new jobs would be first filled by skilled unemployed persons, as this group represents the excess labour force in the region. From Table 2-9, the total number of persons unemployed in the region in construction, machining, transport,

FIGURE 2 COMPARISON OF PEAK MANPOWER REQUIREMENTS OF ALTERNATIVE SCHEMES OF DEVELOPMENT FOR THE LIARD PROJECT - DIRECT EMPLOYMENT ONLY

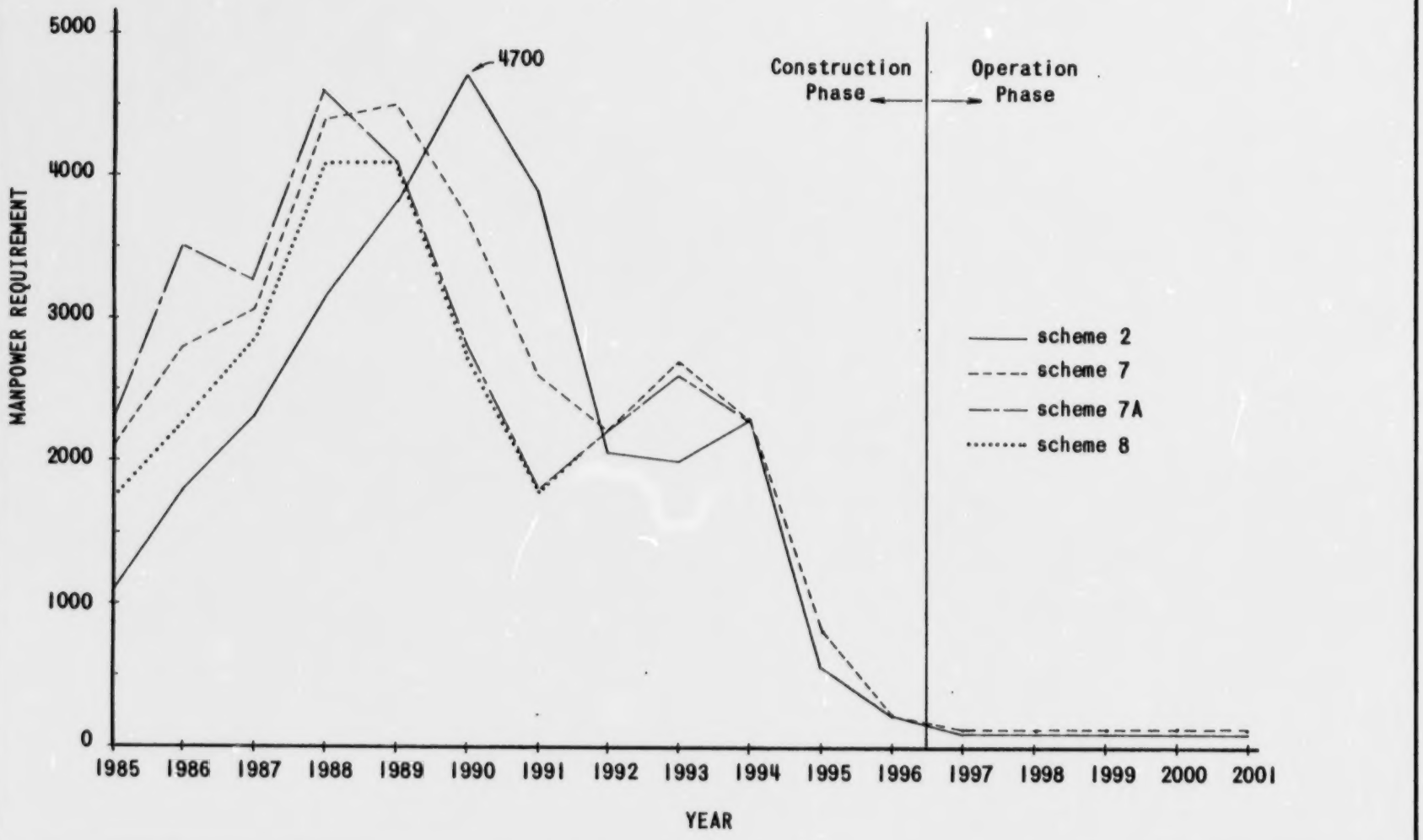

TABLE 4-2

SUPPLY OF SKILLED CONSTRUCTION WORKERS FROM LOCAL AREAS

Year	Unemployed Skilled Worker
1979	40[1]
1980	41
1981	42
1982	42
1983	43
1984	44
1985	45
1986	46
1987	47
1988	48
1989	49
1990	50
1991	51
1992	52
1993	53
1994	54
1995	55
1996	56

[1] Calculated from data on unemployment insurance benefit recipients from Table 2-9. This figure is the total of unemployed persons in construction, machining, transport, fabricating, material handling, forestry and mining. The number of unemployed is assumed to increase by 2 percent annually. The projected labour force supply in the Fort Nelson Region in 1980 to 2001 would increase by 4 percent yearly on the average (B.C. Research, 1979). It is assumed that unemployment would not increase as fast as the labour force supply, but neither would it decrease to the minimum. For the purpose of this exercise, a middle point, 2 percent, is adopted.

fabricating, material handling, forestry and mining amounts to 40. This is assumed to be the local labour force supply. This number is assumed to increase by 2 percent annually (see footnote of Table 4-2).

Table 4-3 shows the labour force supply by origin for all four schemes. As the supply of local labour force is very low, substantial proportions of the direct project jobs would be filled by in-migrant workers from outside Fort Nelson and Watson Lake Regions. Over the entire 12 years of construction, local labour force supply would not likely amount to more than 3 percent of the demand for labour.

(iii) Population Impacts

There are many factors that influence in-migrant workers' decision on whether they would relocate their families. Based on previous B.C. Hydro hydro-electric project experience, such as the Peace Canyon Project, only 5 percent of the in-migrant union workers on the project relocated their families, as compared to nearly 90 percent for non-union supervisory staff. In the Site C Socio-Economic Impact Study (Canadian Resourcecon, 1978), it was assumed that 5 to 25 percent of the in-migrant workers would relocate their families. It is expected that for the Liard project, in the initial construction period of the project, only 10 percent of the in-migrant workers would relocate their families; the percentage would gradually increase to 25 by the peak year of construction and then would taper off to 5 percent towards the last two years of the project construction.

Table 4-4 projects the levels of in-migration induced by direct employment of the Liard project,

TABLE 4-3

ESTIMATED CONSTRUCTION MANPOWER SUPPLY FOR THE LIARD PROJECT

	Scheme 2			Scheme 7			Scheme 7A			Scheme 8		
		Supply			Supply			Supply			Supply	
Year	Demand[1]	Local[2]	In-migration	Demand[1]	Local[2]	In-migration	Demand[1]	Local[2]	In-migration	Demand[1]	Local[2]	In-migration
1985	700	45	655	1250	45	1205	1400	45	1355	1050	45	1005
1986	1200	46	1155	1850	46	1805	2300	46	2255	1500	46	1455
1987	1500	47	1455	2100	47	2055	2200	47	2155	1900	47	1855
1988	2100	48	2050	3000	48	2950	3050	48	3000	2750	48	2700
1989	2650	49	2600	3050	49	3000	2900	49	2850	2900	49	2850
1990	3150	50	3100	2600	50	2550	1950	50	1900	1850	50	1800
1991	2700	51	2650	1850	51	1800	1300	51	1250	1300	51	1250
1992	1450	52	1400	1500	52	1450	1500	52	1450	1500	52	1450
1993	1320	53	1265	1800	53	1745	1800	53	1745	1800	53	1745
1994	1600	54	1545	1600	54	1545	1600	54	1545	1600	54	1545
1995	400	55	345	600	55	545	600	55	545	600	55	545
1996	150	56	95	150	56	95	150	56	95	100	56	45

[1] From Table 4-1, yearly average manpower requirements.

[2] From Table 4-2.

TABLE 4-4

POPULATION IMPACTS RESULTING FROM LIARD PROJECT DIRECT EMPLOYMENT DURING CONSTRUCTION

	Scheme 2					Scheme 7					Scheme 7A					Scheme 8				
Year	Single	Married[1]	Family[2]	Peak[3]	Total	Single	Married	Family	Peak	Total	Single	Married	Family	Peak	Total	Single	Married	Family	Peak	Total
1985	590	65	150	400	1205	1085	120	275	850	2330	1220	135	310	900	2565	905	100	230	700	1935
1986	980	175	400	600	2155	1535	270	620	950	3375	1915	340	775	1200	4230	1235	220	500	750	2705
1987	1235	220	505	800	2760	1750	305	710	950	3715	1835	320	735	1050	3940	1575	280	640	950	3445
1988	1640	410	945	1050	4045	2360	590	1355	1400	5705	2400	600	1380	1550	5930	2160	540	1240	1350	5290
1989	2080	520	1195	1150	4945	2400	600	1380	1450	5830	2280	570	1310	1200	5360	2280	570	1310	1200	5360
1990	2325	775	1780	1550	6430	1915	635	1465	1100	5115	1425	475	1090	850	3840	1350	450	1035	850	3685
1991	1990	660	1520	1200	5370	1350	450	1035	750	3585	940	310	720	510	2480	940	310	720	500	2470
1992	1120	280	645	600	2645	1160	290	665	700	2815	1160	290	665	700	2815	1160	290	665	700	2815
1993	1075	190	435	680	2380	1485	260	600	900	3245	1485	260	600	800	3145	1485	260	600	900	3245
1994	1315	230	530	700	2775	1315	230	535	700	2780	1315	230	535	600	2680	1315	230	530	600	2675
1995	310	35	80	150	575	490	55	125	200	870	490	55	125	200	870	490	55	125	200	870
1996	90	5	10	50	155	90	5	10	50	155	90	5	10	50	155	45	0	0	50	95

[1] Married in-migrant workers are estimated to be 5 to 25 percent of the labour force. First year it is 10 percent, increasing to 25 percent in 6 and 7 years, then it tapers off to 5 percent in the last year.

[2] Family members of married in-migrant workers. Average family size is 3.3 persons.

[3] Additional single in-migrant workers during the peak period.

taking into account the following assumption. The average family size of married in-migrant workers is assumed to be 3.3. This is derived from a survey of families of construction workers on the Peace Canyon Project. The results of this survey are discussed and used in the Site C study (B.C. Hydro, System Engineering Division. 1979). This estimate is very close to that of the existing population in the region (see page 3-7 footnote).

The table indicates that during the peak construction period of the Liard project, total in-migration resulting from direct employment would reach 5400 (Scheme 8) to 6400 (Scheme 2) people.

(b) Indirect Employment Impacts: Construction Phase

(i) Indirect Employment Resulting from Direct Project Employment

Various previous studies have estimated the employment multiplier for the study region. The estimate adopted by this study is 1.8. For a discussion of multiplier derivation, see Section 3.2.

Of all the proposed project sites, none is within easy commuting distances to an existing town of at least 200 people. Both Watson Lake and Fort Nelson are more than 100 km from any project site. Therefore, it is expected that the majority of the labour force would be accommodated in construction camps. These construction camps would generally be self-sufficient. Camp residents may occassionally visit Watson Lake and Fort Nelson for services and goods. However, such demand is not expected to be substantial. Thus, indirect employment would be largely restricted to such

sectors as transportation and construction. Thus, an employment multiplier computed on the basis of the existing economic base would most likely over-estimate indirect employment for the Liard project. For the purpose of this study, a multiplier of 1.3 is used.

Table 4-5 calculates the indirect employment using this multiplier, and combines this with the direct employment to derive the total employment impacts of the Liard project. Overall, Scheme 7 has the highest total man-year employment, followed by Scheme 7A, and then Scheme 2 and Scheme 8 over the 12-year period of construction. However, as evident from the table, the differences appear to be small, about 13 percent between the highest employment inducing scheme and the lowest. With the exception of Scheme 8, all three other schemes have a peak total employment of 4000 to 4100. Scheme 8 would have a peak total employment of 3800.

(ii) Manpower Supply

To estimate the population impact of the indirect employment, the whole forecasting process as discussed in Section 4.1(a)(ii) is reiterated. In this second round of forecasting, some parameters are changed. However, the basic procedures are essentially the same: first, estimate the proportional distribution of the employment between the locally skilled unemployed and the in-migrants, and secondly, determine the proportional distribution of jobs between single and married in-migrants.

Table 4-6 predicts the local labour supply for the indirect employment of the Liard project. Within

TABLE 4-5

ESTIMATED TOTAL EMPLOYMENT CREATED DURING CONSTRUCTION OF THE LIARD PROJECT

	Scheme 2			Scheme 7			Scheme 7A			Scheme 8		
Year	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
1985	700	210	910	1250	375	1625	1400	420	1820	1050	315	1365
1986	1200	360	1560	1850	555	2405	2300	690	2990	1500	450	1950
1987	1500	450	1950	2100	630	2730	2200	560	2760	1900	570	2470
1988	2100	630	2730	3000	900	3900	3050	915	3965	2750	825	3575
1989	2650	795	3445	3050	915	3965	2900	870	3770	2900	870	3770
1990	3150	945	4095	2600	780	3380	1950	585	2535	1850	555	2405
1991	2700	810	3510	1850	555	2405	1300	390	1690	1300	390	1690
1992	1450	435	1885	1500	450	1950	1500	450	1950	1500	450	1950
1993	1320	395	1715	1800	540	2340	1800	540	2340	1800	540	2340
1994	1600	480	2080	1600	480	2080	1600	480	2080	1600	480	2080
1995	400	120	520	600	180	780	600	180	780	600	180	780
1996	150	45	195	150	45	195	150	45	195	100	30	130
man-years			24 595			27 755			26 975			24 505

Note: A multiplier of 1.3 is used to estimate total employment from direct employment.

TABLE 4-6

SUPPLY OF LOCAL MANPOWER FOR INDIRECT EMPLOYMENT DURING THE LIARD CONSTRUCTION PERIOD

Year	Unemployed Worker	Spouses of Workers[1] in Direct Employment Available to Work				Total Local Manpower Supply			
		Scheme 2	Scheme 7	Scheme 7A	Scheme 8	Scheme 2	Scheme 7	Scheme 7A	Scheme 8
1979	140[2]								
1980	143								
1981	146								
1982	149								
1983	152								
1984	155								
1985	158	26	48	54	40	185	205	210	200
1986	161	70	108	136	88	230	270	295	250
1987	165	88	122	128	112	255	285	295	275
1988	168	164	236	240	216	330	405	410	385
1989	171	208	240	228	228	380	410	400	400
1990	175	310	254	190	180	485	430	365	355
1991	178	264	180	124	124	440	360	300	300
1992	182	112	116	116	116	295	300	300	300
1993	185	76	104	104	104	260	290	290	290
1994	189	92	92	92	92	280	280	280	280
1995	193	14	22	22	22	205	215	215	215
1996	197	2	2	2	0	200	200	200	195

[1] Assumes 40 percent of the in-migrants' spouses would participate in the labour force. From Table 2-7, female labour force participation rate in Fort Nelson is .52, in Peace River-Liard Region is .41 and in B.C. is .46.

[2] From Table 2-9, the total number of unemployment insurance benefit recipients is about 180. Forty of them are assumed to have filled some direct jobs of the Liard project. Thus, 140 are available for work in indirect jobs. The number is assumed to grow by 2 percent per year.

the study region, people who are unemployed and who have not taken direct jobs with the Liard project would be available for indirect employment. Also, some spouses of workers who in-migrate to the area to take up direct employment are assumed to participate in the labour force. From Table 2-7, the female participation rate in the labour force in Fort Nelson is .52. For the purpose of this study, a participation rate of .40 is used. This labour pool amounts to 185 to 485 over the 12 years of construction for Scheme 2. The labour pools for the other schemes fall within this range.

Given the local manpower supply, in-migrant work force can be determined. Results are shown in Table 4-7, and suggest a fairly low level of in-migration, varying from 460 persons for Scheme 2 to 500 persons for Scheme 7 during the peak year.

(iii) Population Impacts

It is expected that most supervisory, managerial and professional jobs in the indirect employment sector would be filled by in-migrants. The observed pattern of this group of in-migrants is that they are most likely married and more likely to relocate their families than the other occupational groups. Also, a much higher proportion of indirect employment than direct employment is expected to be located in Fort Nelson and Watson Lake. These permanent, larger communities, with a more comprehensive package of services (education, health care, etc.) are more attractive places to relocate families than construction camps. The ratio of single to married in-migrant workers is assumed to be 1:2. Average family size of married

TABLE 4-7

ESTIMATED MANPOWER SUPPLY FOR INDIRECT EMPLOYMENT DURING THE CONSTRUCTION PERIOD OF THE LIARD PROJECT

	Scheme 2			Scheme 7			Scheme 7A			Scheme 8		
		Supply			Supply			Supply			Supply	
Year	Demand[1]	Local[2]	In-migration	Demand[1]	Local[2]	In-migration	Demand[1]	Local[2]	In-migration	Demand[1]	Local[2]	In-migration
1985	210	185	25	375	205	170	420	210	210	315	200	115
1986	360	230	130	555	270	285	690	295	395	450	250	200
1987	450	255	195	630	285	345	560	295	265	570	275	295
1988	630	330	300	900	405	495	915	410	505	825	385	440
1989	795	380	415	915	410	505	870	400	470	870	400	470
1990	945	485	460	780	430	350	585	365	220	555	355	200
1991	810	440	370	555	360	195	390	300	90	390	300	90
1992	435	295	140	450	300	150	450	300	150	450	300	150
1993	395	260	135	540	290	250	540	290	250	540	290	250
1994	480	280	200	480	280	200	480	280	200	480	280	200
1995	120	205	0	180	215	0	180	215	0	180	215	0
1996	45	200	0	45	200	0	45	200	0	30	195	0

[1] From Table 4-5.

[2] From Table 4-6.

workers is assumed at 3.3 persons. The resulting population projection is shown in Table 4-8. The variations between schemes during the peak year of construction are insignificant. All four schemes would have an in-migrant population ranging from 1175 to 1270 persons at the peak year.

(c) Direct Plus Indirect Population Impacts: Construction Phase

Table 4-9 aggregates the in-migrant population resulting from both direct and indirect employment of the Liard project. Scheme 2 would induce the highest in-migration of 7605 people, in the peak construction year. Scheme 7 and Scheme 7A are similar; about 7100 to 7200 people would be relocating to the region at peak year, while Scheme 8 would add 6545 people. The margin of difference among these four schemes in terms of overall population impacts is less than 15 percent.

Fig. 3 describes these differences graphically.

(d) Employment and Population Impacts: Operation Phase

At the present stage, estimates of direct labour force requirements for the operation phase of the Liard project are still cursory. The following are the estimates for the various project sites: Site A, 45; Site E, 45; Site F, 30; Site G, 30. Longitudinal distribution of this labour force is assumed to resemble that of the Revelstoke project. Table 4-10 presents these estimates. By comparison, Scheme 2 would generate 90 direct jobs, while each of Schemes 7, 7A and 8 would generate 105 direct jobs.

Using an employment multiplier of 1.8 (see Section 3.2), indirect employment is estimated and shown in Table 4-11. The estimates for direct and indirect employment combined are 153

TABLE 4-8

POPULATION IMPACTS RESULTING FROM LIARD PROJECT INDIRECT EMPLOYMENT DURING CONSTRUCTION

	Scheme 2				Scheme 7				Scheme 7A				Scheme 8			
Year	Single[1]	Married	Family[2]	Total	Single[1]	Married	Family[2]	Total	Single[1]	Married	Family[2]	Total	Single[1]	Married	Family[2]	Total
1985	10	15	35	60	60	110	260	430	70	140	320	530	40	75	175	290
1986	45	85	195	325	95	190	430	715	135	260	600	995	70	130	305	505
1987	65	130	300	495	120	225	525	870	90	175	400	665	100	195	445	740
1988	100	200	460	760	170	325	750	1245	170	335	765	1270	150	290	665	1105
1989	140	275	630	1045	170	335	765	1270	155	315	725	1195	160	310	715	1185
1990	150	310	715	1175	120	230	530	880	75	145	335	555	70	130	305	505
1991	125	245	565	935	65	130	295	490	30	60	135	225	30	60	135	225
1992	45	95	220	360	50	100	225	375	50	100	225	375	50	100	225	375
1993	45	90	205	340	85	165	380	630	85	165	380	630	85	165	380	630
1994	65	135	310	510	70	130	305	505	70	130	305	505	70	130	305	505
1995	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[1] Singles constitute one-third of the total in-migrant work force.

[2] Family members of in-migrant workers. Average family size is assumed to be 3.3 persons.

FIGURE 3 COMPARISON OF IN-MAGRANT POPULATION RESULTING FROM THE ALTERNATIVE SCHEMES OF DEVELOPMENT OF THE LIARD PROJECT - BOTH CONSTRUCTION AND OPERATION PHASES

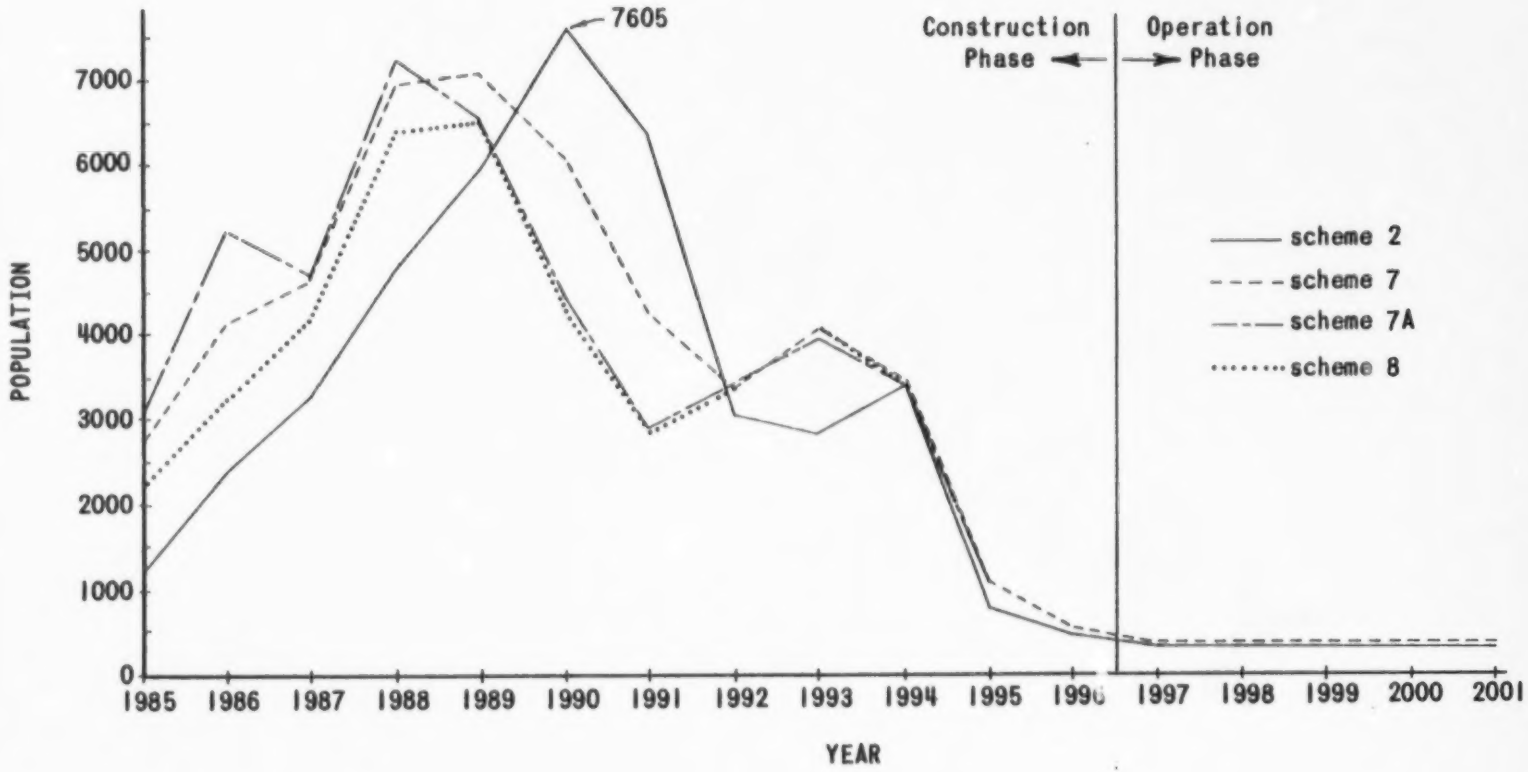

TABLE 4-9

DIRECT PLUS INDIRECT POPULATION IMPACTS DURING THE CONSTRUCTION PERIOD OF THE LIARD PROJECT

	Scheme 2			Scheme 7			Scheme 7A			Scheme 8		
Year	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
1985	1205	60	1265	2330	430	2760	2565	530	3095	1935	290	2225
1986	2155	325	2480	3375	715	4090	4230	995	5225	2705	505	3210
1987	2760	495	3255	3715	870	4585	3940	665	4605	3445	740	4185
1988	4045	760	4805	5705	1245	6940	5930	1270	7200	5290	1105	6395
1989	4945	1045	5990	5830	1270	7100	5360	1195	6555	5360	1185	6545
1990	6430	1175	7605	5115	880	5995	3840	555	4395	3685	505	4190
1991	5370	935	6305	3585	490	4075	2480	225	2705	2470	225	2695
1992	2645	360	3005	2815	375	3190	2815	375	3190	2815	375	3190
1993	2380	340	2720	3245	630	3875	3145	630	3775	3245	630	3875
1994	2775	510	3285	2780	505	3285	2680	505	3185	2675	505	3180
1995	575	0	575	870	0	870	870	0	870	870	0	870
1996	155	0	155	155	0	155	155	0	155	95	0	95
TOTAL			41 445			46 920			44 955			40 655

TABLE 4-10

LIARD PROJECT OPERATION MANPOWER REQUIREMENTS

	Scheme 2			Scheme 7				Scheme 7A				Scheme 8			
Year	Site E	Site A	Total	Site G	Site F	Site A	Total	Site G	Site F	Site A	Total	Site G	Site F	Site A	Total
1989	-	-	-	-	-	-	-	7	-	-	7	7	-	-	7
1990	-	-	-	7	7	-	14	20	-	-	20	20	7	-	27
1991	-	-	-	20	20	-	40	30	7	-	37	30	20	-	50
1992	10	-	10	30	30	-	60	30	20	-	50	30	30	-	60
1993	30	-	30	30	30	-	60	30	30	-	60	30	30	-	60
1994	45	-	45	30	30	-	60	30	30	-	60	30	30	-	60
1995	45	10	55	30	30	10	70	30	30	10	70	30	30	10	70
1996	45	30	75	30	30	30	90	30	30	30	90	30	30	30	90
1997	45	45	90	30	30	45	105	30	30	45	105	30	30	45	105

Source: B.C. Hydro, Environmental Resources Department, 1976.

TABLE 4-11

ESTIMATED DIRECT AND INDIRECT EMPLOYMENT CREATED DURING THE OPERATION PHASE OF THE LIARD PROJECT

	Scheme 2			Scheme 7			Scheme 7A			Scheme 8		
Year	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
1989	-	-	-	-	-	-	7	6	13	7	6	13
1990	-	-	-	14	11	25	20	16	36	27	22	49
1991	-	-	-	40	32	72	37	30	67	50	40	90
1992	10	8	18	60	48	108	50	40	90	60	48	108
1993	30	24	54	60	48	108	60	48	108	60	48	108
1994	45	36	81	60	48	108	60	48	108	60	48	108
1995	55	44	99	70	56	126	70	56	126	70	56	126
1996	75	60	135	90	72	162	90	72	162	90	72	162
1997	90	72	162	105	84	189	105	84	189	105	84	189

Note: An employment multiplier of 1.8 is used.

permanent jobs for Scheme 2 and 179 permanent jobs for each of the other alternative schemes.

All permanent jobs are expected to be filled by in-migrants. On the assumptions that one-third of the in-migrant work force is single, and that of those who are married, half of their spouses would participate in the work force, the total in-migrant work force can be determined. Table 4-12 presents the estimates, and calculates the total number of people who would relocate into the study region as a result of the Liard project.

Schemes 7, 7A and 8 all would generate higher in-migration than Scheme 2 in the operation phase, 340 people in the case of the former, and 290 in the case of the latter.

(e) Total Employment Impacts: Construction and Operation

Table 4-13 combines results from Tables 4-5 and 4-11 to present the overall employment impacts of the Liard project under the alternative schemes of development. Since the construction phase and the operation phase overlap very little, the short-term and long-term impacts remain separate.

(f) Total Population Impacts: Construction and Operation

Table 4-14 and Fig. 3 summarize the total project impacts on population resulting directly and indirectly from the employment opportunities, by combining results from Tables 4-9 and 4-12.

The project will produce a substantial influx of people to the region, regardless of which scheme is selected. The peak years would witness a population increase of 6600 to 7600 people, which would be twice the size of the existing population of the Liard Region. Because the project has a long period of construction, 12 years, and because the proposed project sites are distant

TABLE 4-12

POPULATION IMPACTS RESULTING FROM LIARD PROJECT EMPLOYMENT DURING THE OPERATION PHASE

	Scheme 2				Scheme 7				Scheme 7A				Scheme 8			
Year	Single	Married	Dependent	Total	Single	Married	Dependent	Total	Single	Married	Dependent	Total	Single	Married	Dependent	Total
1989	-	-	-	-	-	-	-	-	4	9	11	24	4	9	11	24
1990	-	-	-	-	8	17	22	47	12	24	29	65	16	33	40	89
1991	-	-	-	-	24	48	58	130	22	45	54	121	30	60	72	162
1992	6	12	14	32	36	72	86	194	30	60	72	162	36	72	86	194
1993	18	36	43	97	36	72	86	194	36	72	86	194	36	72	86	194
1994	27	54	65	146	36	72	86	194	36	72	86	194	36	72	86	194
1995	33	66	79	178	42	84	101	227	42	84	101	227	42	84	101	227
1996	45	90	108	243	54	108	130	292	54	108	130	292	54	108	130	292
1977	54	108	130	292	63	126	151	340	63	126	151	340	63	126	151	340

Notes:
1. Assumes one-third of the in-migrant work force is single.
2. Assumes 50 percent of spouses of married in-migrants would work.
3. An average family size of married workers is assumed at 3.3 persons.

TABLE 4-13

ESTIMATED TOTAL EMPLOYMENT DURING BOTH CONSTRUCTION AND OPERATION PHASES OF THE LIARD PROJECT

	Scheme 2			Scheme 7			Scheme 7A			Scheme 8		
Year	Construction	Operation	Total	Construction	Operation	Total	Construction	Operation	Total	Construction	Operation	Total
1985	910	-	910	1625	-	1625	1820	-	1820	1365	-	1365
1986	1560	-	1560	2405		2405	2990	-	2990	1950	-	1950
1987	1950	-	1950	2730	-	2730	2760	-	2760	2470	-	2470
1988	2730	-	2730	3900	-	3900	3965	-	3965	3575	-	3575
1989	3445	-	3445	3965	-	3965	3770	13	3783	3770	13	3783
1990	4095	-	4095	3380	25	3405	2535	36	2571	2405	49	2454
1991	3510	-	3510	2405	72	2477	1690	67	1757	1690	90	1780
1992	1885	18	1903	1950	108	2058	1950	90	2040	1950	108	2058
1993	1715	54	1769	2340	108	2448	2340	108	2448	2340	108	2448
1994	2080	81	2161	2080	108	2188	2080	108	2188	2080	108	2188
1995	520	99	619	780	126	906	780	126	906	780	126	906
1996	195	135	330	195	162	357	195	162	357	130	162	292
1997	-	162	162	-	189	189	-	189	189	-	189	189

TABLE 4-14

TOTAL POPULATION IMPACTS DURING BOTH CONSTRUCTION AND OPERATION PHASES OF THE LIARD PROJECT

	Scheme 2				Scheme 7				Scheme 7A				Scheme 8			
	Construction Phase		Operation		Construction Phase		Operation		Construction Phase		Operation		Construction Phase		Operation	
Year	Direct	Indirect	Phase	Total[1]	Direct	Indirect	Phase	Total[1]	Direct	Indirect	Phase	Total[1]	Direct	Indirect	Phase	Total[1]
1985	1205	60	-	1265	2330	430		2760	2565	530	-	3095	1935	290	-	2225
1986	2155	325	-	2480	3375	715	-	4090	4230	995	-	5225	2705	505	-	3210
1987	2760	495	-	3255	3715	870	-	4585	3940	665	-	4605	3445	740	-	4185
1988	4045	760	-	4805	5705	1245	-	6950	5930	1270	-	7200	5290	1105	-	6395
1989	4945	1045	-	5990	5830	1270	-	7100	5360	1195	24	6580	5360	1185	24	6570
1990	6430	1175	-	7605	5115	880	47	6040	3840	555	65	4460	3685	505	89	4280
1991	5370	935	-	6305	3585	490	130	4205	2480	225	121	2825	2470	225	162	2855
1992	2645	360	32	3035	2815	375	194	3385	2815	375	162	3350	2815	375	194	3385
1993	2380	340	97	2815	3245	630	194	4070	3145	630	194	3970	3245	630	194	4070
1994	2775	510	146	3430	2780	505	194	3480	2680	505	194	3380	2675	505	194	3375
1995	575	-	178	755	870	-	227	1095	870	-	227	1095	870	-	227	1095
1996	155	-	243	400	155	-	292	445	155	-	292	445	95	-	292	385
1997	-	-	292	290	-	-	340	340	-	-	340	340	-	-	340	340

[1] The figures are rounded off to the nearest 5 persons.

from existing town sites (other than isolated settlements along the Alaska Highway), accommodation of the large labour force and the resultant in-migrant population would require more detailed study and planning. It is expected that a large majority of the in-migrant population would have to be accommodated in work camps, some of which might be made permanent townsites to accommodate the operation work force.

Table 4-15 further compares the net population impacts of various potential developments in the Liard Region, including the following alternative scenarios: development with the Pipeline project only; development with the Liard project only; and development with both the Liard and the Pipeline. Overall, the Liard project alone would generate substantial population increases. Compared to the Liard project, the Pipeline would have relatively mild population impacts. Under the scenario where both projects were to take place, the Liard Region would witness a population upsurge between 1983 and 1994, with in-migration of 2400 to 6800 people as one extreme, or 3500 to 7400 people as the other extreme, over this period. In-migration would then taper off at the 500 or 600 level in the following year or two.

Table 4-16 provides new projections for the Liard Region population under the various future development scenarios. As discussed in Section 3.2, some out-migration would take place under the "no project" scenario. Under the "both projects" scenario, population in the peak year of development (Scheme 2 as the highest extreme) would be close to 90 percent higher than if no development were to occur. Between 1983 and 1996, if both projects were to proceed with construction, the overall population in this period would increase by 40 percent* over the "no project"

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* This is the averaged annual percentage difference over this period.

TABLE 4-15

ESTIMATED IN-MIGRANT POPULATION UNDER VARIOUS DEVELOPMENT SCENARIOS

Year	With Pipeline Only	With Liard Only				With Pipeline and Liard			
		2	7	7A	8	2	7	7A	8
1980	0	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0	0	0
1983	700	0	0	0	0	700	700	700	700
1984	3500	0	0	0	0	3500	3500	3500	3500
1985	2700	1300	2800	3100	2200	3900	5500	3300	2400
1986	200	2500	4100	5200	3200	2400	4300	5400	3400
1987	200	3300	4600	4600	4200	3000	4800	4800	4400
1988	200	4800	7000	7200	6400	4300	7200	7400	6600
1989	200	6000	7100	6600	6600	5200	7300	6800	6800
1990	200	7600	6000	4500	4300	6700	6300	4700	4500
1991	200	6300	4200	2800	2900	5600	4400	3000	3100
1992	200	3000	3400	3400	3400	3300	3600	3600	3600
1993	200	2800	4100	4000	4100	3000	4300	4200	4300
1994	200	3400	3500	3400	3400	3700	3700	3600	3600
1995	200	800	1100	1100	1100	1000	1300	1300	1300
1996	200	400	400	400	400	600	700	700	600
1997	200	300	300	300	300	500	600	600	600
1998	200	300	300	300	300	500	600	600	600
1999	200	300	300	300	300	500	600	600	600
2000	200	300	300	300	300	500	600	600	600
2001	200	300	300	300	300	500	600	600	600

Note: Figures are rounded off the nearest 100 persons.

TABLE 4-16

POPULATION PROJECTIONS UNDER VARIOUS DEVELOPMENT SCENARIOS

Year	Population Without the Pipeline and the Liard (a)	Population With the Pipeline but Without the Liard	Population With the Liard but Without the Pipeline				Population With both the Pipeline and the Liard				Percentage (%) Difference between (a) and (b)
			2	7	7A	8	2 (b)	7	7A	8	
1980	6 900	6 900	6 900	6 900	6 900	6 900	6 900	6 900	6 900	6 900	0
1981	7 300	7 300	7 300	7 300	7 300	7 300	7 300	7 300	7 300	7 300	0
1982	7 500	7 500	7 500	7 500	7 500	7 500	7 500	7 500	7 500	7 500	0
1983	7 900	8 600	7 900	7 900	7 900	7 900	8 600	8 600	8 600	8 600	10
1984	8 100	11 600	8 100	8 100	8 100	8 100	11 600	11 600	11 600	11 600	40
1985	8 200	10 900	9 500	11 000	11 300	10 400	12 200	13 700	14 000	13 100	50
1986	7 800	8 000	10 300	11 900	13 000	11 000	10 500	12 100	13 200	11 200	40
1987	8 100	8 400	11 400	12 700	12 700	12 300	11 600	12 900	12 900	12 500	40
1988	8 300	8 500	13 100	15 300	15 500	14 700	13 300	15 500	15 700	14 900	60
1989	8 500	8 800	14 500	15 600	15 100	15 100	14 700	15 800	15 300	15 300	70
1990	9 000	9 300	16 600	15 000	13 500	13 300	16 800	15 200	13 700	13 500	90
1991	9 500	9 700	15 800	13 700	12 300	12 400	16 000	13 900	12 500	12 600	70
1992	9 800	10 000	12 800	13 200	13 200	13 200	13 000	13 400	13 400	13 400	30
1993	10 000	10 200	12 800	14 100	14 000	14 100	13 000	14 300	14 200	14 300	30
1994	10 300	10 600	13 700	13 800	13 700	13 700	13 900	14 000	13 900	13 900	30
1995	10 600	10 800	11 400	11 700	11 700	11 700	11 600	11 900	11 900	11 900	10
1996	11 000	11 200	11 400	11 400	11 400	11 400	11 600	11 600	14 600	11 600	10
1997	11 200	11 500	11 500	11 500	11 500	11 500	11 700	11 700	11 700	11 700	4
1998	11 500	11 700	11 800	11 800	11 800	11 800	12 000	12 000	12 000	12 000	4
1999	11 800	12 000	12 100	12 100	12 100	12 100	12 300	12 300	12 300	12 300	4
2000	12 000	12 300	12 300	12 300	12 300	12 300	12 500	12 500	12 500	12 500	4
2001	12 300	12 500	12 600	12 600	12 600	12 600	12 800	12 800	12 800	12 800	4

scenario. In the long-run, the difference in population between these two scenarios is approximately 4 percent. Among the four schemes, the differences of both the long-term and the short-term impacts are almost negligible, particularly between Schemes 7 and 7A. Fig. 4 graphically presents these findings.

(g) Population Displacement

For comparison purposes, Table 4-17 summarizes the direct displacement effect of the Liard project on settlements by alternative scheme of development. The factors considered include direct flooding of settlements, total number of people potentially displaced from their original townsites, total number (by type) of businesses potentially displaced from their original townsites and flooding of Indian reserves. Flooding of Indian reserves is included, because it represents a direct impact on the Indian community. A detailed examination of impacts on Indians in the Liard, however, is not provided in this study. The issue is a topic of another study being conducted by B.C. Hydro.

Of all four schemes, Scheme 7 has the greatest displacement impact, followed by Scheme 7A. Schemes 2 and 8 both generate the least impact in terms of settlement displacement. Either Schemes 7 or 7A would flood one or two Indian settlements and more reserve lands than the other two schemes. Neither Scheme 2 nor 8 would flood the Indian communities. All four schemes would flood at least one reserve, the Muddy River Indian reserve (70 ha).

The extent to which the population in these settlements would relocate outside the study region is not yet certain. However, it is likely that very little out-of-region relocation would result. Settlements such as Lower Post and Upper Liard have a long history in the region. As for the highway service-oriented settlements, relocation would most likely be from the existing

FIGURE 4 POPULATION PROJECTION FOR THE LIARD REGION UNDER ALTERNATIVE SCENARIOS OF DEVELOPMENT 1980-2001

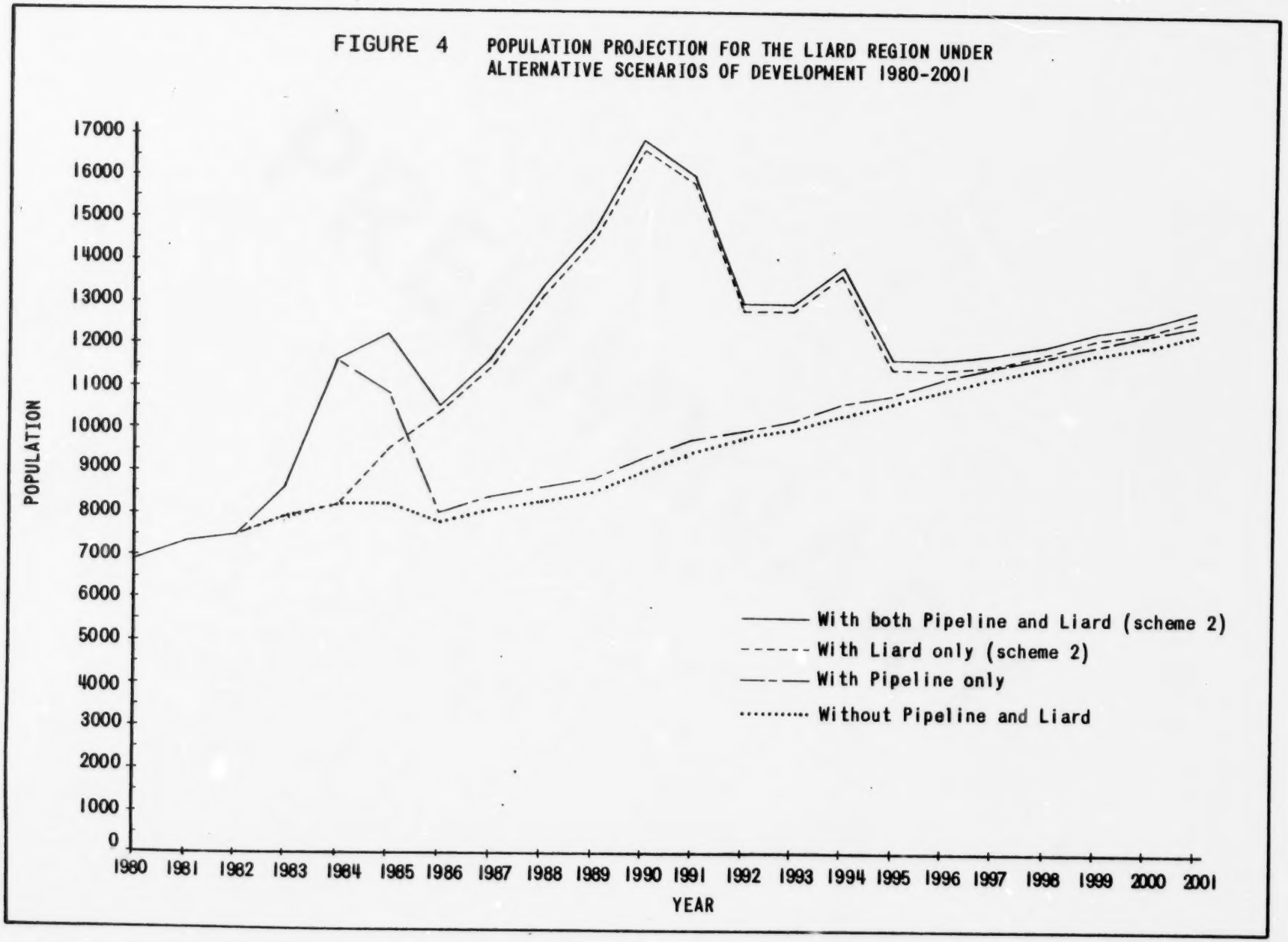

TABLE 4-17

COMPARISON OF DISPLACEMENT IMPACTS OF LIARD HYDROELECTRIC PROJECT
ON SETTLEMENTS BY ALTERNATIVE SCHEME OF DEVELOPMENT

Impact	Scheme 2	Scheme 7	Scheme 7A	Scheme 8
	Dam E - 571.5 m Dam A - 390 m	Dam G - 625 m Dam F - 503 m Dam A - 445 m	Dam G - 610 m Dam F - 503 m Dam A - 445 m	Dam G - 571.5 m Dam F - 503 m Dam A - 445 m
Settlement Displacement:				
Lower Liard Crossing 435 m	flooded	probably flooded	probably flooded	probably flooded
Coal River 474 m	flooded	flooded	flooded	flooded
Fireside 512 m	flooded	probably displaced	probably displaced	probably displaced
Lower Post 585 m	not flooded	flooded	flooded	not flooded
Contact Creek 610 to 640 m	probably displaced	flooded	probably flooded	probably displaced
Irons Creek 670 m	probably displaced	probably displaced	probably displaced	probably displaced
Watson Lake 685 m	not flooded	not flooded	not flooded	not flooded
Upper Liard 615 m	not flooded	flooded	not flooded	not flooded
Number of People Potentially Displaced	40	380	190	40
Number of Businesses Potentially Displaced	20	28	25	20
Flooding of Indian Reserves:				
Muddy River 70 ha	Yes	Yes	Yes	Yes
Liard River 217 ha	No (70 ha)	Yes (287 ha)	Yes (287 ha)	No (70 ha)

Alaska Highway to the new highway, because service demand generated by the new highway traffic would remain little changed. Service functions performed by these settlements are just as essential for the new highway. Thus, on these assumptions, it is estimated that population displacement resulting from flooding of the Liard River would not lead to net population loss within the study region. However, this does not take into account the possibility that the project would generate negative impacts on the tourist industry upon which many of these settlements' economic viability relies. Settlements so displaced would not be the direct result of the project. This impact would more appropriately be examined as a recreation impact to be studied separately.

(h) Income Impact

Similar to employment impact, increases in basic income (wages, salaries accruing to direct employment of the project) would, through spending and respending, generate a proportional increase in nonbasic income. In order to estimate the total income of both sectors, an income-expenditure multiplier for the Liard Region would have to be established. Developing this multiplier itself, would constitute a detailed separate study.

Due to the lack of knowledge of this basic-nonbasic income relationship in the Liard Region, this study resorts to the simpliest means of estimating the income impacts of the project, which is multiplying the total employment generated by the Liard project, including direct and indirect for both construction and operation, by a prescribed average income wage for this employment. Table 4-18 shows the results of this computation. The average per capita wage is assumed to be $20,000 per annum (1980 dollar value). The results of this exercise should be interpreted with caution, as a crude estimate of the income effect.

TABLE 4-18

INCOME (WAGES AND SALARIES ONLY) ACCRUING FROM THE LIARD PROJECT BY SCHEME OF DEVELOPMENT

	Scheme 2		Scheme 7		Scheme 7A		Scheme 8	
Year	Employment	Income ($0000)	Employment	Income ($0000)	Employment	Income ($0000)	Employment	Income ($0000)
1985	910	1 820	1 625	3 250	1 820	3 640	1 365	2 730
1986	1 560	3 120	2 405	4 810	2 990	5 980	1 950	3 900
1987	1 950	3 900	2 730	5 460	2 760	5 520	2 470	4 940
1988	2 730	5 460	3 900	7 800	3 965	7 930	3 575	7 150
1989	3 445	6 890	3 965	7 930	3 883	7 766	3 783	7 566
1990	4 095	8 190	3 405	6 810	2 571	5 142	2 454	4 908
1991	3 510	7 020	2 477	4 954	1 757	3 514	1 780	3 560
1992	1 903	3 806	2 058	4 116	2 040	4 080	2 058	4 116
1993	1 769	3 538	2 448	4 896	2 448	4 896	2 448	4 896
1994	2 161	4 322	2 188	4 376	2 188	4 376	2 188	4 376
1995	619	1 238	906	1 812	906	1 812	906	1 812
1996	330	660	357	714	357	714	292	584
1997	162	324	189	378	189	378	189	378
Total Construction Period (1985-1996)		49 964		56 928		55 370		50 538

Note: 1. Average wage is assumed to be $20 000 per annum.

2. Total income is at 1980 dollar value.

4.1 POPULATION, EMPLOYMENT, INCOME IMPACTS - (Cont'd)

The income impact of the 12 years of construction would amount to $499.64 million (1980 dollar value) for Scheme 2, the lowest of all schemes, and $569.28 million (1980 dollar value) for Scheme 7, the highest. The difference is 19 percent.

In the operation phase, total wages and salaries generated by the Liard project would amount to $3.24 million (1980 dollar value) per year for Scheme 2, and $3.78 million (1980 dollar value) per year for the other three schemes, a difference of 17 percent.

4.2 IMPACT ON REGIONAL INFRASTRUCTURE

It is expected that a large majority of the work force during the construction phase would be living in work camps, some of which could become permanent townsites. The selection of such townsites and the planning of new infrastructure are under study.

At this stage of the analysis, it is difficult to predict the spatial distribution of the project related work force and its families. To do so requires more detailed information on the number and types of jobs, both direct and indirect, because this affects the types of personnel and the characteristics of their families, which in turn affects the types and the location of housing and related facilities to accommodate them.

In this section, only a general discussion on housing requirements and related infrastructure is provided.

(a) Housing and Municipal Services

During the peak construction period, in-migration is expected to total 5120 households in the case of Scheme 2, which represents the high extreme, and 4530 households in the case of Scheme 8, representing the low extreme (Table 4-19). This implies

TABLE 4-19a

ESTIMATED NUMBER OF IN-MIGRANT HOUSEHOLDS ACCRUING FROM THE LIARD PROJECT, CONSTRUCTION AND OPERATION (SCHEME 2)

	Construction				Operation		Construction and Operation		
	Direct		Indirect						
Year	Single	Family	Single	Family	Single	Family	Single	Family	Total
1985	990	70	10	20	-	-	1000	90	1090
1986	1580	180	50	90	-	-	1630	270	1900
1987	2040	220	70	130	-	-	2110	350	2460
1988	2690	410	100	200	-	-	2790	610	3400
1989	3230	520	140	280	-	-	3370	800	4170
1990	3880	780	150	310	-	-	4030	1090	5120
1991	3190	660	130	250	-	-	3320	910	4230
1992	1720	280	50	100	10	10	1780	390	2170
1993	1760	190	50	90	20	20	1830	300	2130
1994	2020	230	70	140	30	40	2120	410	2530
1995	460	40	-	-	30	40	490	80	570
1996	140	10	-	-	50	60	190	70	260
1997	-	-	-	-	50	70	50	70	120

Note: Figures are rounded off to the nearest 10 households.

TABLE 4-19b

ESTIMATED NUMBER OF IN-MIGRANT HOUSEHOLDS ACCRUING FROM THE LIARD PROJECT, CONSTRUCTION AND OPERATION (SCHEME 7)

Year	Construction				Operation		Construction and Operation		
	Direct		Indirect						
	Single	Family	Single	Family	Single	Family	Single	Family	Total
1985	1940	120	60	110	-	-	2000	230	2230
1986	2490	270	100	190	-	-	2590	460	3050
1987	2700	310	120	230	-	-	2820	540	3360
1988	3760	590	170	330	-	-	3930	920	4850
1989	3850	600	170	340	-	-	4020	940	4960
1990	3020	340	120	230	10	10	3150	580	3730
1991	2100	450	70	130	20	30	2190	610	2800
1992	1860	290	50	100	40	50	1950	440	2390
1993	2390	260	90	170	40	50	2520	480	3000
1994	2020	230	70	130	40	50	2130	410	2540
1995	690	60	-	-	40	60	730	180	910
1996	140	10	-	-	50	70	190	80	270
1997	-	-	-	-	60	80	60	80	140

Note: Figures are rounded off to the nearest 10 households.

TABLE 4-19c

ESTIMATED NUMBER OF IN-MIGRANT HOUSEHOLDS ACCRUING FROM THE LIARD PROJECT, CONSTRUCTION AND OPERATION (SCHEME 7A)

	Construction				Operation		Construction and Operation		
	Direct		Indirect						
Year	Single	Family	Single	Family	Single	Family	Single	Family	Total
1985	2120	140	70	140	-	-	2190	280	2470
1986	3120	340	140	260	-	-	3260	600	3860
1987	2890	320	90	180	-	-	2980	500	3480
1988	3950	600	170	340	-	-	4120	940	5060
1989	3480	570	160	320	-	10	3640	900	4540
1990	2280	480	80	150	10	20	2370	650	3020
1991	1450	310	30	60	20	30	1530	400	1930
1992	1860	290	50	100	30	40	1940	430	2370
1993	2290	260	90	170	40	50	2420	480	2900
1994	1920	230	70	130	40	50	2030	410	2440
1995	690	60	-	-	40	60	730	120	850
1996	140	10	-	-	50	70	190	80	270
1997	-	-	-	-	60	80	60	80	140

Note: Figures are rounded off to the nearest 10 households.

TABLE 4-19d

ESTIMATED NUMBER OF IN-MIGRANT HOUSEHOLDS ACCRUING FROM THE LIARD PROJECT, CONSTRUCTION AND OPERATION (SCHEME 8)

Year	Construction				Operation		Construction and Operation		
	Direct		Indirect						
	Single	Family	Single	Family	Single	Family	Single	Family	Total
1985	1610	100	40	80	-	-	1650	180	1830
1986	1990	200	70	130	-	-	2060	330	2390
1987	2530	280	100	200	-	-	2630	480	3110
1988	3510	540	150	290	-	-	3660	830	4490
1989	3480	570	160	310	-	10	3640	890	4530
1990	2200	450	70	130	20	20	2290	600	2890
1991	1440	310	30	60	30	40	1500	410	1910
1992	1860	290	50	100	40	50	1950	440	2390
1993	2390	260	90	170	40	50	2520	480	3000
1994	1920	230	70	130	40	50	2030	410	2440
1995	690	60	-	-	40	60	730	120	850
1996	100	-	-	-	50	60	150	70	220
1997	-	-	-	-	60	80	60	80	140

Note: Figures are rounded off to the nearest 10 households.

a housing demand ranging from 4530 to 5120 units, depending on which scheme would be chosen. Of this total number of housing units demanded, close to 90 percent would be for housing workers directly employed by the hydro development, while the remaining 10 percent would be for housing in-migrants and their families relocating to the region to take up indirect employment. Single person households represent roughly 90 percent of the total in-migrant households in the first year of construction when employment is at its low level. At the peak of construction, single person households would represent 80 percent of the total in-migrant households.

Variations between the alternative schemes in housing demand are not substantial. The two extremes differ by about 13 percent, which reflects the degree of differences of these schemes in population and employment.

The number of in-migrant households expected to relocate to the region in the operation phase of the Liard project would be relatively small, and it varies little among the alternative schemes of development. To accommodate the single personnel, about 50 to 60 housing units would be required, and 70 to 80 family units would be needed for accommodating those who are married.

Of the 4500 to 5000 estimated households expected to relocate to the region during the peak year of construction, it is doubtful if very many of them would live either in Watson Lake or Fort Nelson. In the case of the Peace Canyon Project near Fort St. John, where the construction site is within commuting distances to the adjacent townsites, only 25 percent of the work force chose to live in the existing towns. The remaining 75 percent chose to live in construction camps. Thus, the proportion of the in-migrant work force choosing to reside in Fort Nelson and

Watson Lake would almost certainly be less than 25 percent, and possibly much lower, as these existing communities are not even within commuting distances to the proposed Liard project sites. As for the 120 to 140 households relocating to the region on a permanent basis in the operation phase, an alternative to Fort Nelson and Watson Lake would be a new townsite in between the two. Feasibility of this alternative would require further study.

The current water and sewerage system in the Village of Fort Nelson is capable of accommodating a population up to 8000. In terms of possible land for residential development, the Village has land available in the north and west, totalling 320 ha which can accommodate a population addition of up to 10 000, depending on the housing mix (Hollmann, 1979c). If the housing demand resulting from the Liard project on the existing communities were to be at a low level of not more than 10 percent of the total housing demand accruing from the Liard project, or 500 units, in the peak construction year, and less than 100 units during post construction years, as anticipated, the Village should have sufficient land available to accommodate all these, in addition to the demand from its own natural growth. Nonetheless, the demand during construction would be relatively short-term and high in magnitude. At present, the Village has a housing stock of 1780 units, with a very low vacancy rate of less than 1 percent. Although housing starts between 1977 and 1979 had increased at a fast pace, from 85 units to 262 units, (Hollmann, 1979c), whether the short-term demand of 500 units in ten years time would constitute a strain on the housing supply of the Village is difficult to forecast at this stage. Much depends on future housing provision policies and changes in the overall housing demand patterns over the next ten year period.

4.2 IMPACT ON REGIONAL INFRASTRUCTURE - (Cont'd)

In terms of potential housing and community infrastructure impacts on Watson Lake, the Liard project would play a relatively unimportant role, when compared to the total anticipated impacts accruing from other potential economic activities in the region. In the study of the Economic Potential of the Watson Lake Region (Government of the Yukon Territory, Economic Research and Planning Unit, 1978), a population impact of one-third the current population of the region by the year 1990 is expected to result from the various anticipated economic developments, not even including the Pipeline project, in the region. Currently, Watson Lake L.I.D. has a water system operating at one-third its capacity. The sewage treatment facility, however, needs to be expanded and upgraded to incorporate further growth. In fact, such expansion scheme is already underway. The L.I.D. has an area of 576 ha. It is estimated that only a third of the available land has been used to its full capacity. With careful planning, the anticipated population growth can be accommodated.

(b) Other Community Services and Facilities

Requirements for additional schools, teaching staff and the like facilities depend on the size of the child population. Again, at this stage of the analysis, it is difficult to determine the locational distribution of such facilities. The forecast of such requirements provided here serves as a general indication of the order of magnitude of the impacts rather than as absolute measures.

Table 4-20 estimates the size of the in-migrant child population and the number requiring schooling. The estimates are derived from previous forecasts on the married in-migrant population and its average family size for both construction and operation, and for both direct and indirect employment (Tables 4-4, 4-8 and 4-12). In the Peace Canyon Project household survey, it is found that not more than 60 percent of the child population are at

TABLE 4-20

ESTIMATED NUMBER OF SCHOOL AGE CHILD IN-MIGRANTS ACCRUING FROM THE LIARD PROJECT, CONSTRUCTION AND OPERATION

	Scheme 2			Scheme 7			Scheme 7A			Scheme 8		
Year	Construction	Operation	Total	Construction	Operation	Total	Construction	Operation	Total	Construction	Operation	Total
1985	70	-	70	180	-	180	220	-	220	140	-	140
1986	210	-	210	360	-	360	470	-	470	260	-	260
1987	270	-	270	420	-	420	390	-	390	370	-	370
1988	480	-	480	720	-	720	730	-	730	650	-	650
1989	620	-	620	730	-	730	690	10	700	690	10	700
1990	850	-	850	440	10	450	490	20	510	410	20	430
1991	710	-	710	450	20	470	290	20	310	300	30	330
1992	300	10	310	300	40	340	300	30	330	300	40	340
1993	220	20	240	340	40	380	340	40	380	340	40	380
1994	290	30	320	280	40	320	300	40	340	280	40	320
1995	30	30	60	90	50	140	50	50	100	50	50	100
1996	10	50	60	10	50	60	10	50	60	-	60	60
1997	-	50	50	-	60	60	-	60	60	-	60	60

school ages, as married in-migrants were generally younger couples. It is expected that the Liard project would not induce an in-migrant population with family characteristics substantially different from that of the Peace Canyon Project. Thus, for the purpose of this analysis, 60 percent of the child population is expected to attend school.

The size of the child population does not appear to vary substantially among schemes. The school population would reach a maximum level of 700 to 850 during the peak construction year. However, over the period of construction, the size of school age children would vary substantially from year to year. In light of this boom-bust nature of the school population, mobile school units are expected to be employed. Similarly, the number of teachers would vary with the school population. It is estimated that 35 to 40 new teachers would be required at the peak year of construction, assuming a teacher-student ration of 1:20. At the operation stage, the increase in the number of school children would be nonsubstantial, amounting to 50 to 60 children.

Existing school and educational facilities in Fort Nelson would have to be expanded to absorb these increases in addition to the natural growth, facilities are operating at their capacities.

In terms of health care resources, the present 41 bed hospital in Fort Nelson has a capacity to serve a population of 8000. Under natural growth conditions, this capacity would be reached by 1994 (Table 3-1), but if the net out-migration scenario were true (Table 3-4), this capacity can be extended for another year or two. However, with both the Liard project and the Pipeline Project, the capacity of the existing hospital would have to be expanded by 1984 in order to serve the additional population, or substitute facilities would have to be arranged. Even without

the Pipeline project, the Liard project alone would warrant expansion of the hospital by 1985 or 1986 at the latest.

Currently, Fort Nelson has three doctors, giving a physician population ratio of 1:1700. This ratio is relatively low when compared to the provincial ratio of 1:600. Referral cases are treated in the south. This practice is not expected to change until Fort Nelson reaches a population threshhold equivalent to Prince George or Kamloops, which is not foreseen in this century. Thus, it is expected that most work contracts related to the Liard project would contain provisions that injured or diseased workers be flown south for treatment. However, for primary health care, Fort Nelson is still the resource centre for the region's population. Thus, to serve an additional population of 6600 to 7600 people accruing from the Liard Project, at the peak of the construction year, it is estimated that an addition of 10 to 13 doctors would be required.

Requirements for additional police force depend not only on population size, but also on criminal workload. Although available statistics suggest that the crime rate in the Fort Nelson area is on the rise (see Section 4.3), precise prediction on future crime rate increases is difficult to make. Thus, police force requirement is estimated on the basis of population size only. The Fort Nelson Police Detachment covers the whole Fort Nelson Region from the Village of Fort Nelson to Lower Post, serving a population of approximately 5000. It presently has 13 policemen of which 10 are on general duty policing and the remaining three on highway patrol (traffic). The Liard Project at the peak year of construction would generate an increased population of 6600 to 6800. This necessitates an increase in the police force of 17 to 20 men. The establishment of construction camps at the various dam sites during the project construction period may also necessitate the creation of a separate detachment.

4.3 SOCIAL IMPACT

Apart from the direct impact of relocating communities from the flooded areas and of disrupting the existing life styles of local residents, including native people, trappers, guides, and local businessmen, the most often expressed local concerns regarding the Liard project are problems associated with potential transients and the psychological impact of the boom-bust phenomenon.

By comparison, Scheme 7 would have the highest negative impact in terms of community dislocation. A total of 380 persons and 28 businesses would be displaced. Scheme 7A would displace half the population of Scheme 7, but would affect almost as many businesses (25). Both schemes would inundate at least one Indian settlement. Schemes 2 and 8 would be less disruptive. A total of 40 people and 20 businesses would be affected in either case. For most individuals and families forced relocation is a stressful and disruptive experience. For the native people, the impact would be loss of food supply and income generating resources. Lacking the necessary skills and training they are least likely to benefit from the alternative wage employment opportunities offered by the project.

In terms of indirect social impact, many local residents express fear that existing communities would suffer from increased social problems, such as alcoholism and crimes, as a result of the "boom-town" phenomenon. Such concerns were voiced during the recent Northern British Columbia Public Hearings on Proposed Socio-Economic and Environmental Terms and Conditions for the Alaska Highway Gas Pipeline in November of 1979, although many acknowledged the economic benefit (job creation and income generation) which would be brought about by the project. Such are local residents' general reaction toward any large scale developments, but there is little reason to assume local attitudes toward the Liard project would be different.

Discount value	-	price or cost of a commodity depreciated or appreciated using an appropriate interest rate to reflect its terminal worth at the time it is evaluated
Experienced labour force	-	persons 15 years of age or over who are working in a specified profession at least for a week prior to the census date
Hinterland	-	generally referred to as the rural or frontier region from which a major metropolis or urban centre draws its supplies of natural resources or agricultural products
Income-expenditure multiplier	-	a mathematical model which describes the increase in total regional income as a result of each additional dollar of export sales or of wage spending in a region
Indirect employment	-	jobs created in other sectors of the economy as a result of a new industry, either to provide services to the employees directly employed by the new industry or to facilitate sales and purchases between the new industry and its supplying or purchasing establishments

Infrastructure	-	generally means utilities or facilities which are built to service the population needs of a region or a community, such as roads, sewerage systems, gas lines, and so on
In-migrant	-	a person who moves from outside the region but within the country
Inter economic linkages	-	sales and purchases among industries between a region and the outside markets
Intra economic linkages	-	sales and purchases among industries within a region
Labour force participation rate	-	the percentage of population 15 years of age or over who are working or want to work for a wage
Longitudinal distribution	-	distribution over time
Nonbasic employment	-	jobs which produce goods and services to serve the needs of the basic or export industries in the region, or jobs not directly involved in production for export from the region
Nonbasic income	-	income generated from sales of goods and services for non-exporting purposes

Primary health care	-	care that is provided at first contact between the patient and the health care professional for promotion and maintenance of health and for complete and continuous care for the individual, including referral when required
Social indicator	-	factors generally accepted in the field of social studies for measuring the quality of social life on a macro scale
Wage employment	-	jobs which are rewarded for with a monetary payment, usually on a contract basis, as opposed to non-wage employment which is not rewarded by monetary means